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South Dakota Air Quality Maintenance Area Analysis

PEDCo-Environmental Specialists, Inc, Cincinnati, Ohio

Prepared for

Environmental Protection Agency, Denver, Colo Air Planning and Operations Section

Jun 76

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This report contains air pollutant emissions estimates, air quality data and dispersion modeling for the base year (present) in AQMA counties in the State of South Dakota. Projections of emissions and air quality (using dispersion modeling) are made for 1980 and 1985. The adequacy of the existing South Dakota State Implementation Plan to provide for the attainment and maintenance of the National Ambient Air Quality Standards is discussed.

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SOUTH DAKOTA AIR QUALITY MAINTENANCE AREA ANALYSIS

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Suite 13, Atkinson Square
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Contract No. 68-02-1375
Task Order No. 19

EPA Project Officer: David Kircher

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
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Mr. David Kircher was the project officer for the U.S. Environmental Protection Agency. Mr. Roger Stead was the principal contact with the South Dakota Department of Environmental Protection. The author is appreciative of their assistance and cooperation.

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1. INTRODUCTION

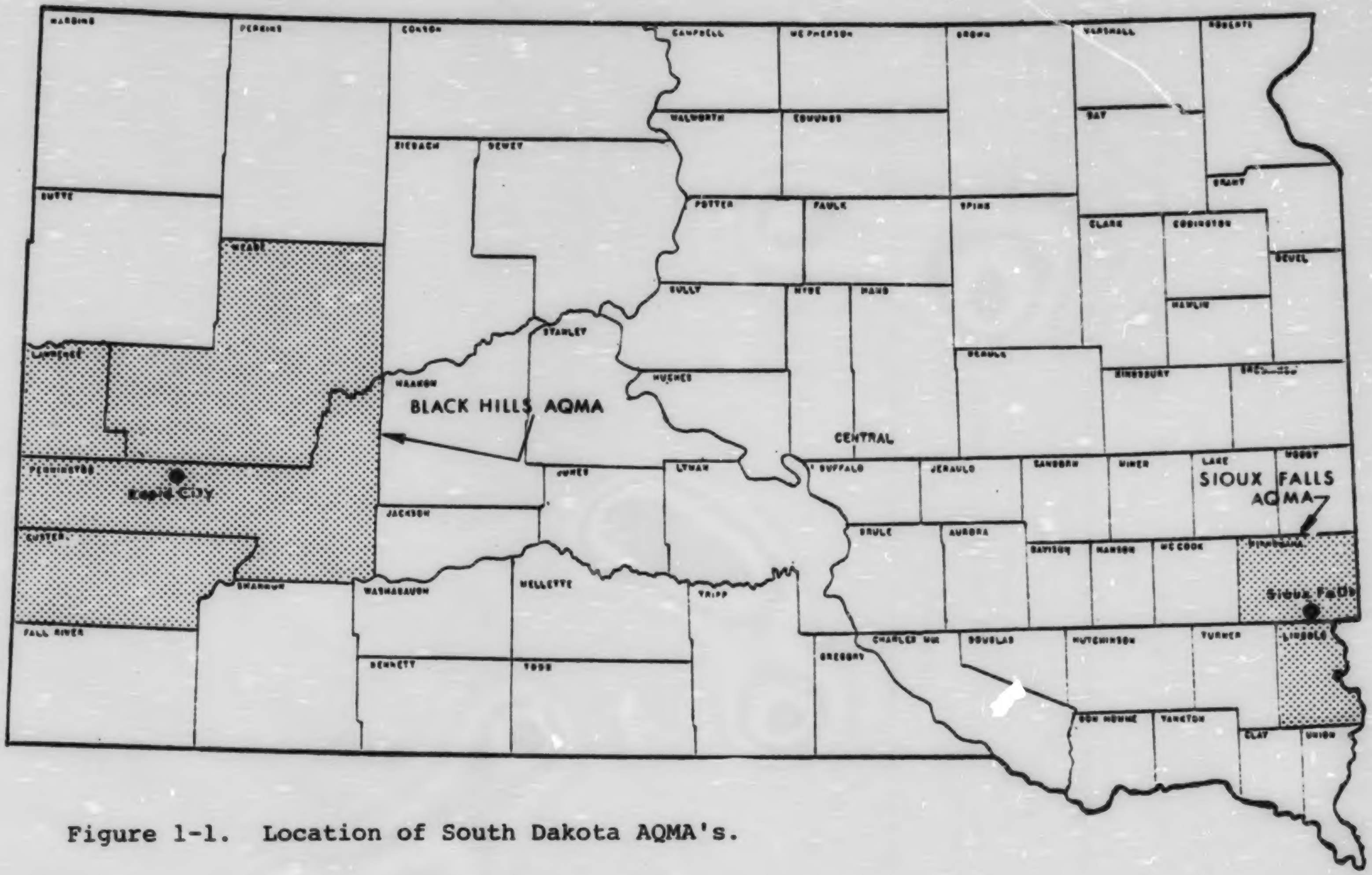
The Administrator of the U.S. Environmental Protection Agency (EPA) has identified two areas in South Dakota which have the potential to exceed the National Ambient Air Quality Standards (NAAQS) for particulates because of existing air quality and/or projected growth over the next ten years (1975 to 1985). EPA has published these areas as designated Air Quality Maintenance Areas (AQMA's). The two AQMA's are Black Hills and Sioux Falls, both of which are designated for particulates only. Figure 1-1 shows the location of the two AQMA's.

Once designated as an AQMA, a detailed analysis of the impact of projected growth and resource development on air quality is required. This report presents such an analysis for the two areas.

If the AQMA analysis demonstrates that neither the primary nor secondary NAAQS will be exceeded, no plan for maintenance of standards is required and the AQMA can possibly be de-designated. However, should the analysis show a problem in attaining the NAAQS by 1975 and/or maintaining the standards in the future, revisions to the South Dakota State Implementation Plan (SIP) and development of an Air Quality Maintenance Plan (AQMP) may very well be required.

The procedures used in the AQMA analysis are consistent with the proposed regulations on maintenance of National Ambient Air Quality Standards, 40 CFR, Part 51.[1] Table 1-1 shows the primary and secondary NAAQS for particulate matter.

South Dakota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POTTER
FAULK
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HYDE
HAND
HAMLIN
LAWRENCE
STANLEY
HAAKON
HUGHES
BEADLE
KINGSBURY
BROOKINGS
BLACK HILLS AQMA
CENTRAL
PENNINGTON
Rapid City
JONES
LYMAN
BUFFALO
JERAULD
SANBORN
MINER
LAKE
MOODY
SIOUX FALLS AQMA
JACKSON
BRULE
AURORA
DAVISON
HANSON
MC COOK
MINNEHAHA
CUSTER
SHANNON
WASHABAUGH
MELLETTE
TRIPP
Sioux Falls
FALL RIVER
CHARLES MIX
DOUGLAS
HUTCHINSON
TURNER
LINCOLN
GREGORY
BENNETT
TODD
BON HOMME
YANKTON
CLAY
UNION

Figure 1-1. Location of South Dakota AQMA's.

Table 1-1. NATIONAL AMBIENT AIR QUALITY STANDARDS FOR PARTICULATES

Pollutant	Frequency	Primary NAAQS, ug/m^3	Secondary NAAQS, ug/m^3
Suspended particulate	Annual geometric mean	75	60
	Maximum 24 hours[a]	260	150

[a] Not to be exceeded more than once per year.

An AQMA analysis consists of the following steps:

- Define the analysis area to be modeled;
- Select the atmospheric diffusion model;
- Identify base year and calculate point source and area source emissions;
- Develop an area source grid system and allocate county area source emissions to the grids and assign point source emissions accordingly;
- Identify projection years and develop growth factors/projection parameters and project all emissions;
- Validate diffusion model for base year and apply the model for projection years;
- If necessary, evaluate compliance with short-term standards by statistical modeling or other appropriate means;
- Draw appropriate conclusions.

A base year of 1974 was used in validating the AQMA modeling. This was the most recent year for which complete data could be obtained. Projection years of 1980 and 1985 were used since a ten year planning period is specified in the proposed regulations for areas in which no other federally sponsored planning programs have been conducted.[1] Also, this fulfilled the requirement in the guidelines of analyzing for five year intervals. Although the two AQMA's are both designated 208 planning areas, activities under these programs have not yet progressed to the stage of developing demographic projections. As projections for 208 activities become available, these will be checked for consistency with those projections used in the AQMA analysis.

The AQMA analysis focuses predominantly on projected annual average concentrations. Short-term maximum concentrations, however, were examined quantitatively in the Sioux Falls AQMA, recognizing the increased uncertainty of predicting short-term variations in future occurrences and of determining the joint probability of maximum predicted emission rates coinciding with adverse meteorological conditions. This analysis was necessary due to the closeness of the predicted 1980 and 1985 annual geometric means to the secondary standard.

This report is divided into three major chapters: Chapter 2 summarizes the findings of the two AQMA analyses; Chapter 3 includes a detailed analysis of the Black Hills AQMA; and Chapter 4 presents the detailed analysis of the Sioux Falls AQMA.

2. SUMMARY

The analyses in both AQMA's utilized current, comprehensive emission inventory data and state-of-the-art regional modeling techniques to predict annual average particulate concentrations from emission estimates. The AQMA analyses were conducted in accordance with procedures prescribed in proposed Federal Regulations (40 CFR, Part 51, Subpart D)[1] and the series of AQMA guideline documents prepared by EPA. Therefore, the analyses are considered to be complete and assembled using the best available data and procedures.

The AQMA analysis of the Black Hills AQMA-Rapid City area showed that the annual primary and secondary particulate NAAQS's have not been attained in several areas in Rapid City and will probably continue to be exceeded through 1980 and 1985 under existing air pollution control regulations. Therefore, both an attainment and a maintenance problem are indicated.

The major cause of these high particulate concentrations in the base year 1974 was shown to be almost equally distributed between mineral products industry related point sources (51 percent) and fugitive dust sources (49 percent), primarily unpaved roads, paved roads, gravel pits, construction, and aggregate storage. In this region, these two usually separable and distinct source categories are closely related, as almost all industrial activity is mineral products related with both well-defined point process emissions and ill defined, ubiquitous fugitive dust emissions.

In consonance with the projection methods and assumptions used in the analysis, by 1985 the predominant impact will be from fugitive dust sources (76 percent) in areas with the worst predicted air quality, with point sources accounting for 24 percent of the particulate loading. Impacts resulting from secondary development over the analysis period were shown to be negligible.

It must be recognized that the accuracy of the Black Hills AQMA analysis is limited by several factors:

- estimates of emissions from fugitive dust source categories;
- uncertainty of projected industrial expansion;
- assumption that particulate emission density in an area is directly proportional to measured air quality;
- unrepresentative indications of air quality in grid 4 by high volume sites 8 and 9 due to sampler placement.

The last factor warrants additional consideration. It is questionable whether sites 8 and 9 (Ben Frieze Enterprises and Cement Plant) should be used as indicators of regional air quality or in determining attainment and maintenance of NAAQS because of their extreme source oriented exposure, which portends site bias and probable interference. Ideally, they should be relocated away from the immediate area of the quarries and the cement and power plants to a suitable location considered more representative of urban air quality.

Additionally, it should be noted that the worst predicted air quality is expected to occur in two grids (1 and 4) peripheral to the Rapid City urban area, which are relatively devoid of residential development and suburban centers.

A summary of the magnitude and extent of NAAQS violations for particulates in the Rapid City area follows:

Grid[a]	Highest expected annual concentration, ug/m3 1974	1980	1985	Extent of area violating NAAQS, sq mi
1	300	230	255	1.5
2	107	60	63	2.9
4	480	375	410	2.2
7	92	78	80	2.0

[a] refer to Figure 3-2.

The Rapid City area was specified for modeling because it is the only area in the AQMA that has identified current high concentrations or the possibility of increasing concentrations as a result of development or industrial growth. The remainder of the AQMA consists of forested unpopulated terrain and small satellite towns devoid of heavy industrial concentration. Sources such as teepee wood waste burners were scattered and removed far enough from urban centers that they do not constitute a significant threat to air quality in the AQMA.

The air quality predictions made herein are considered reasonably accurate, considering the problems attendant to modeling an area characterized by complex terrain. Due to the cyclical nature of the economy in the AQMA, i.e., the dependence on construction and building products raw materials, it is possible that with a significant increase in building and construction activity in surrounding states, a rise in industrial output and growth accompanied by a measurable deterioration of air quality could occur in the AQMA. This, however, is impossible to predict at this time.

The AQMA analysis of the Sioux Falls AQMA showed that the annual primary and secondary particulate NAAQS were being maintained in the analysis base year of 1974. Over most of the area, ambient levels are shown to be only 5-10 ug/m^3 over background (35 ug/m^3). By 1980 and through 1985 respectively, projected levels in the northwest central part of Sioux Falls are predicted to approach and slightly exceed the secondary standard (60 ug/m^3) under existing air pollution control regulations.

The major cause of this deterioration in air quality from 1974 to 1985 is due to normal urban growth, i.e., population expansion and increases in industrial activity. In 1974, point source process emissions accounted for approximately 11 percent of the particulate loading while all area sources constituted around 89 percent. This ratio is expected to change only slightly by 1985 to 10 percent and 90 percent, respectively. It must be noted that within the area source category, emissions due to fugitive dust from paved and unpaved roads account for 6,610 tons per year in 1974, or 63 percent of the total. In 1985 this reduces somewhat to 61 percent and 5,717 tons per year. Clearly then, fugitive dust emissions by these two categories are of major concern in resolving the maintenance problem indicated for 1985.

The AQDM predicted source contribution from all point sources to the TSP concentrations at the five maximum receptors in 1974 was an average 31 percent, while that for area sources was 69 percent.

The accuracy of the Sioux Falls AQMA analysis and model was limited by:

- estimates of emissions from fugitive dust categories;
- uncertainty of projected industrial growth;
- source-receptor relationships estimated by a Gaussian diffusion model;

- determination of background air quality.

The highest predicted annual average concentrations (geometric) in 1974, 1980, and 1985 were 55, 58, and 61 ug/m^3, respectively.

The results of the short-term TSP analysis conducted for Sioux Falls showed that the short-term secondary standard may be expected to be exceeded in all three analysis years, as perceived by the current monitoring stations. The expected 24-hour maximum at the City Hall station in 1985 was calculated to be 235 ug/m^3.

In summary, the results of the analyses indicate the need for development of an attainment plan and an AQMP for particulates in the Black Hills AQMA and an AQMP in the Sioux Falls AQMA.

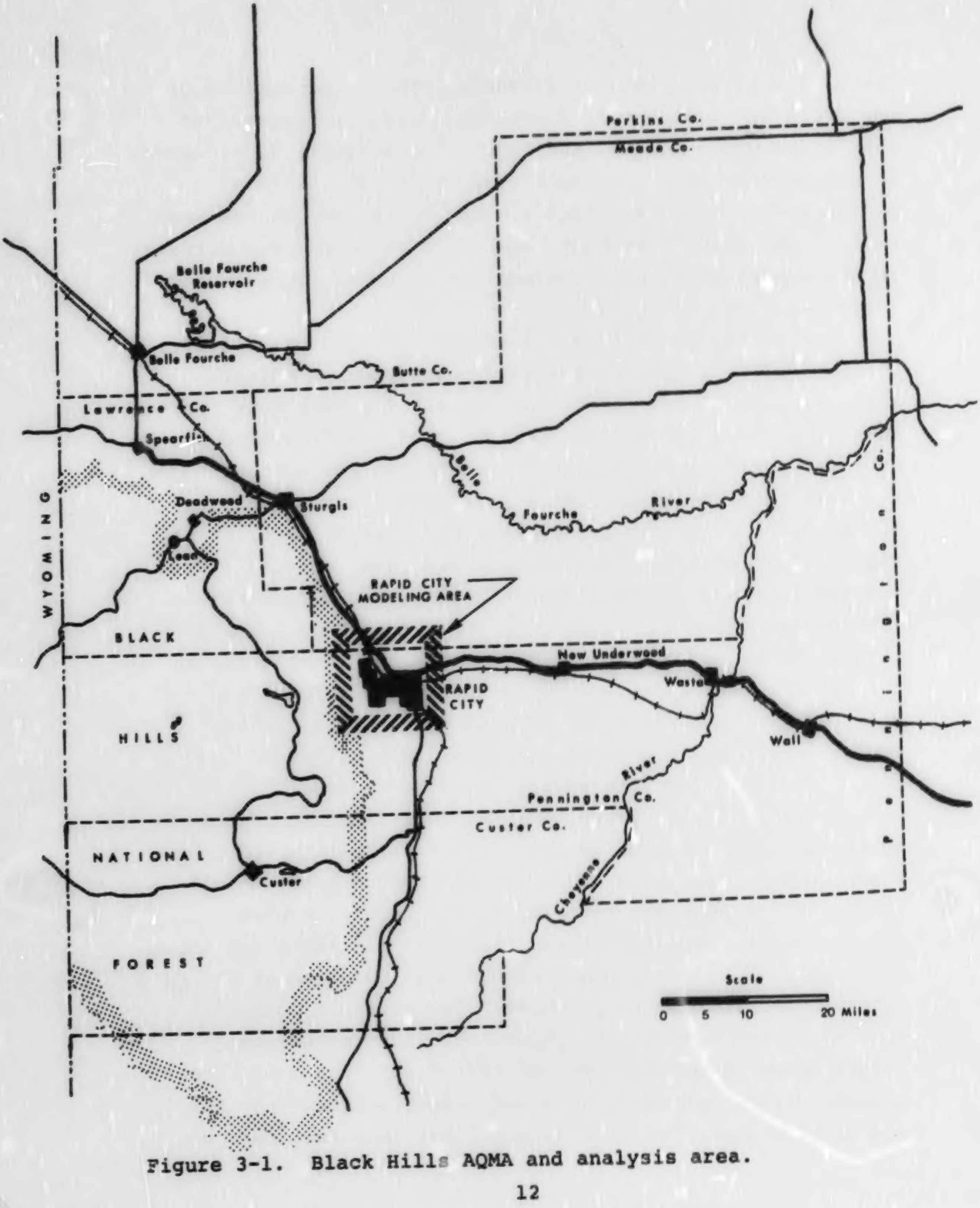
3. BLACK HILLS AQMA

ANALYSIS AREA

The Black Hills AQMA was designated for suspended particulates due to the concern expressed over prior non-attainment problems and existing violations of the NAAQS in several areas in Rapid City. Although current demographic projections normally used to identify AQMA's do not indicate the potential for substantial changes in air quality due to urban development alone, the possibility for industrial expansion combined with the existing problems dictated the need for this datailed AQMA analysis.

The four-county (Pennington, Meade, Lawrence, Custer) AQMA is located in the west central part of the state. It has a land area of approximately 8,750 square miles and is composed of contrasting land forms, with the forested Black Hills rising immediately west of Rapid City, and rolling prairie extending out in the other directions. From 40 to 70 miles southeast lie the eroded "Badlands." The Black Hills, many of which are more than 5,000 feet above sea level, with a number of peaks above 7,000 feet, exert a pronounced influence on the climate of this area. The rolling land to the east of Rapid City is cut by the valleys of the Box Elder and Rapid Creeks, which flow generally east-southeastward. Figure 3-1 depicts the AQMA and analysis area.

Rapid City is the largest city in the AQMA, and is located just southwest of its center in Pennington County. A steep rising north-south ridge, parallel to the front range of the Black Hills due west, bisects the two major commercial/industrial districts and effectively separates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Butte Co.
Lawrence Co.
Spearfish
WYOMING
Deadwood
Sturgis
Lead
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RAPID CITY MODELING AREA
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HILLS
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FOREST
New Underwood
Wasta
RAPID CITY
Wall
Pennington Co.
Custer Co.
Custer
Cheyenne River
Pennington Co.
Scale
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Figure 3-1. Black Hills AQMA and analysis area.

the city into two distinct airsheds. The major portion of the urban and residential development lies to the east of this ridge while most of the industrial activity is situated on either side of a limestone ridge that extends in a northwesterly direction from the center of town on the west side of the major bisecting ridge. In addition, the terrain is characterized by numerous smaller canyons, ridges, and irregularities.

The estimated 1975 population of the AQMA was 111,227, while Rapid City estimated a 1975 population of 48,442, approximately 44 percent of the total. The next four largest towns--Deadwood, Spearfish, Sturgis, and Lead--have populations of 2,419 to 5,442 each.[2] Population projections[3] indicate that the total AQMA population is expected to increase approximately 1.0 percent per year to 1985, while Rapid City forecasts a 2.3 percent per year increase.[2] The average increase for the secondary towns in the counties (above) is less than 0.6 percent per year. Expected population expansion in the remaining towns and rural areas in the AQMA is negligible. Clearly then, with respect to possible future impacts on air quality caused by urban expansion, if any are likely to occur, Rapid City is the only AQMA area likely to reflect these impacts.

At present, the Sixth District Council of Local Governments has no listing of any new industrial plants or plant expansions.[3] The types of industries that may potentially locate in the AQMA are revealed by the type that have located in the recent past and new plant inquiries for the area received by the Industrial Division, Department of Economic and Tourism Development. Two distinct possibilities exist relative to new plant locations in the near future based upon expressed interest: (1) if and when the housing market recovers, a strong possibility exists that one or more timber-related durable goods manufacturers would locate in the AQMA region; and (2) the location of manufacturers of electrical components or plastic medical products. Total expected potential employment in each category would be in the range of 200-500. Any industrial growth activity most likely will occur adjacent to the major transportation networks within the AQMA study area. Historical trends and data indicate that the majority of manufacturing activity will be located within the Rapid City metropolitan area. The industrial manufacturing structure of Rapid City is relatively diversified as opposed to the outlying communities that are closely tied to the area's resources.

Since Rapid City was shown by virtue of historical air quality trends, population and industrial concentration, and capacity for future growth to be the only existing or potential problem area in the AQMA, it was the singular area selected for air quality analysis and predictions. Most existing point sources except for several feed and grain elevators, construction companies, sawmills, and wigwam burners, most of which are located in Custer and Sturgis, are located in the Rapid City area.

METHODOLOGY

The methods used in the AQMA analysis of the Black Hills AQMA are consistent with those described in the EPA guideline series for air quality maintenance planning and analysis with the exception of the modeling technique applied, which will be described and justified below.

Modeling

Two multiple source atmospheric dispersion models are available with capabilities of predicting annual average pollutant concentrations throughout a study area: Air

Quality Display Model (AQDM)[4] and Climatological Dispersion Model (CDM).[5] Both of these models employ Gaussian plume dispersion and frequency distributions of annual meteorological conditions. Both are generally applicable only to flat or rolling terrain. Since the Rapid City area generally consists of irregularly shaped* valleys and ridges, both of these models were necessarily excluded from consideration.

Alternatively then, two types of atmospheric simulation techniques were considered for determining annual particulate concentrations in the Rapid City area: (1) the ventilated valley (box) model; and (2) emission density versus air quality relationships. Although local mixing height data were available, the difficulty in adapting the box model to areas with irregularly shaped terrain excluded it from consideration. Therefore, the most feasible, reasonable approach in this case was to employ the empirical relationship between calculated particulate emission density and measured air quality to estimate annual average concentrations.

The following data were required in order to determine the emission density versus air quality relationship:

- location of sampling sites and air quality data for 1974;
- "microinventory" area and grid size and location;
- emissions for each grid.

The Rapid City area was divided into ten grids which are composed of areas similar in topography and development

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*Terrain elevation gradients of 200 to 700 feet per mile are predominant in this area, as seen in Figure 3-2.

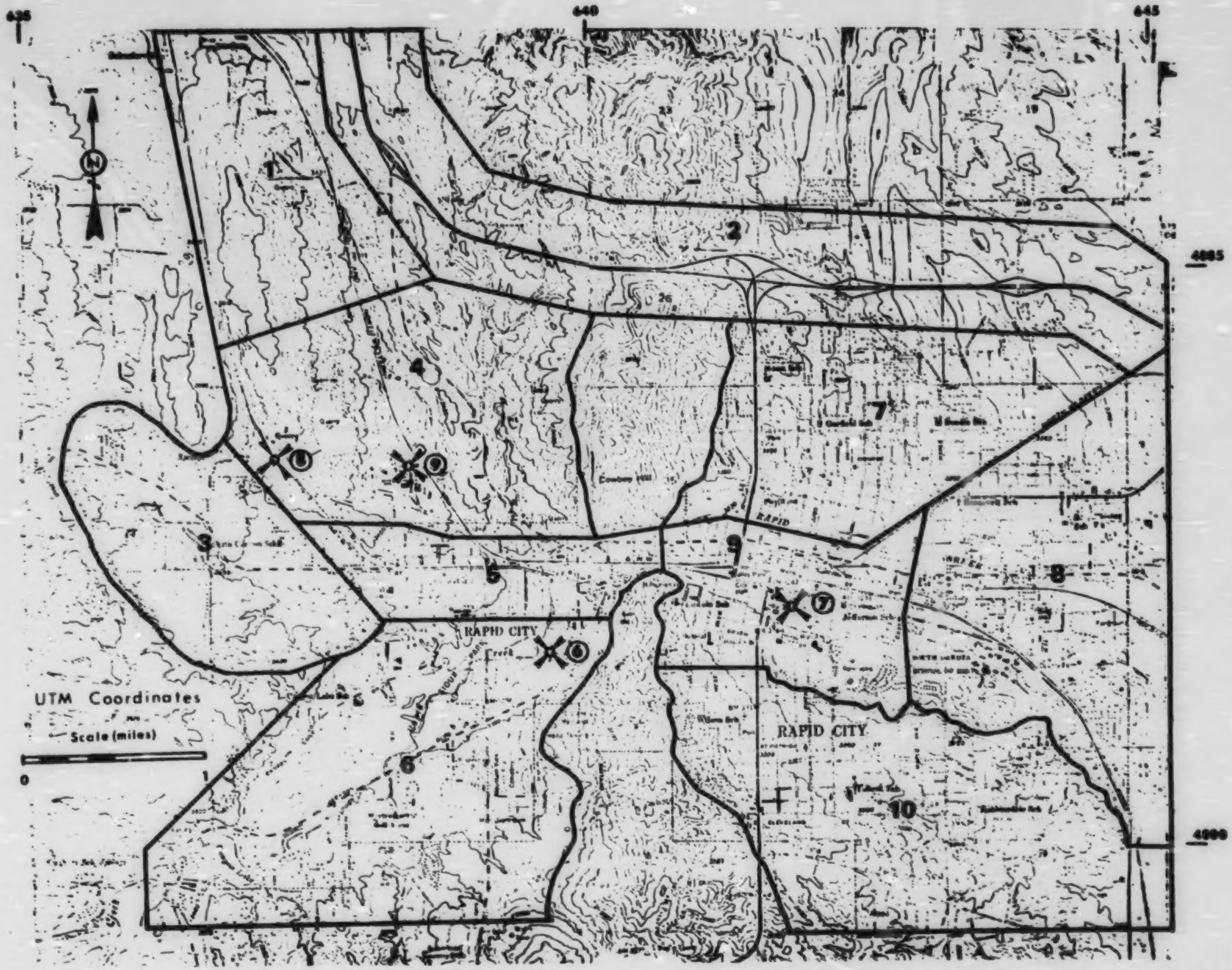
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Figure 3-2. Rapid City area source grids and sampler locations.

type and density (Figure 3-2). Area source and point source emissions were calculated, the emission density determined for each grid, and the air quality estimated from a plot of emission density versus measured concentration (developed in a subsequent section). It is recognized that this technique does not consider sampling site bias or inter-grid pollutant transport phenomena. Additionally, it assumes uniform grid emissions distribution and that ground level emission density is directly proportional to particulate air quality. However, it is presently the most practical method of estimating annual regional particulate levels for areas such as Radpid City that have complex terrain and contain predominantly area sources and fugitive dust sources.

Location of Sources

The locations of all major existing point sources in the Rapid City modeling area are shown in Figure 3-3. Universal Transverse Mercator (UTM) coordinates for each source were obtained from NEDS listings and permit applications and checked by locating on USGS quadrangle maps. No new or proposed sources were identified or located due to the paucity of related information. The UTM coordinates, as well as pertinent identification and emission information for each point source, are cross-referenced by the source ID numbers in Figure 3-3 to the point source listing for Pennington County presented in Appendix A (Table A-1). The point sources for the other Black Hills AQMA counties are not summarized therein, as they are widely distributed and are assumed to have no effect on the Rapid City analysis.

The spatial distribution of area sources was specified by means of the grid system previously described (Figure 3-2).

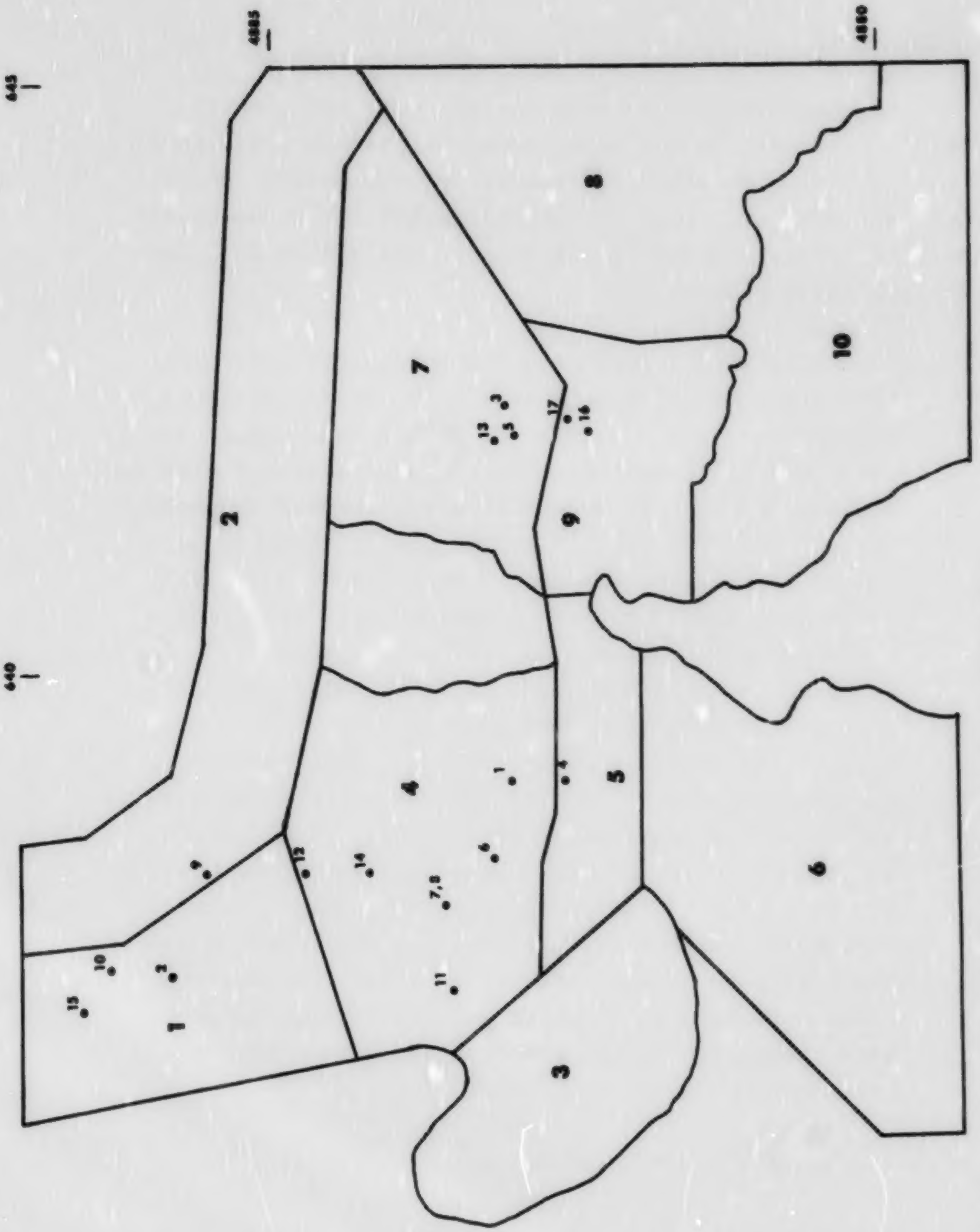
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Figure 3-3. Rapid City point source locations.

Meteorology

Meteorological data were not directly required for input to a model, since this technique assumes that ground level emission density is directly proportional to particulate air quality. However, an understanding of the general meteorological climate of Rapid City will aid in defining the pollution problem.

> "The meteorology of a region greatly determines the effect of pollutants once they are emitted into the atmosphere. The direction of travel, the dispersion rate, and the amount of dilution are connected with the air movements. Northwesterly winds prevail throughout most of the year in this region directing pollutants toward Rapid City. There are an average of (only) 15.2% calm days per year in Rapid City. This fact indicates that prolonged pollution buildups resulting in episodes are improbable. It also allows for good atmospheric dispersion and pollutant dilution during most of the year. However, the area is sometimes subject to short periods of poor atmospheric dispersion and temporary temperature inversions. These periods are linked to the diurnal cycle with atmospheric stability occurring on cold, clear nights. During such periods of stagnation, pollutants tend to accumulate in the basins on either side of the ridge and over the western portion of Rapid City. The inversions occur more frequently during the fall and winter months and occasionally during the summer."[6]

EMISSIONS--BASE YEAR AND PROJECTED

Pollutant emissions were summarized in two major categories for the purpose of calculating grid emission density and estimating air quality: (1) point sources, and (2) area sources. Area sources were further identified as being of conventional origin or fugitive dust* related.

Point Sources

Most of the industrial point sources in Rapid City are situated on either side of the northwesterly extending limestone ridge bounded by Deadwood Avenue on the east and Highway 79 on the west. Point source emission data for the base year 1974 and source identification parameters were obtained from NEDS reports supplied by PES, Inc. Emission estimates for those sources for which the NEDS data were unavailable were made from data supplied on South Dakota Department of Environmental Protection permit applications and variance requests. Generally, the NEDS data were incomplete and lacked sufficient identification information. This made necessary the reliance on less accurate and specific methods to arrive at emission estimates, i.e., the application of emission factors to production data on permit applications. A listing of the affected point sources with their emissions, compliance status, and data source is presented in Table 3-1. Detailed data may be obtained by cross-referencing the selected map point ID numbers (Figure 3-3) with the source summary listing (Table A-1).

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*Fugitive dust sources embrace those open atmospheric dust sources consisting of operations which involve the mechanical disturbance of granular material exposed to the air environment. The dust generated is termed "fugitive" because it is not discharged to the atmosphere in a conventional flow stream. The dust generation process is comprised of pulverization and abrasion of surface material, and entrainment of dust particles by the action of turbulent air currents.

Table 3-1. POINT SOURCE EMISSIONS IN THE RAPID CITY ANALYSIS AREA

Map point ID no.	Source name/type	Compliance status	Data Source	Particulate emissions, ton/yr[a] 1974	1980[b]	1985[b]
1	Black Hills Power and Light/power plant	out	e	449	381	438
2	Snow Brite Lime Co./lime processing	in	e	76	94	109
3	Light Aggregates, Inc./shale processing	out	e	306	61	70
4	Hills Materials Co./asphalt batch	in	e	8	10	11
5	Hills Materials Co./asphalt batch	in	e	11	14	16
6	South Dakota Cement Plant/cement mfg.	in	e	221	274	316
7	Pete Lien & Sons Quarry/gravel quarry	in	e	129	160	184
8	Pete Lien & Sons Lime/lime mfg.	out	e	2161+	273	315
9	Summit, Inc./asphalt batch	out	e	1216	300	346
10	Highway Construction Co./rock crushing	out	f	900	35	40
11	Hills Materials Co./sand & gravel	in	e	132	164	189
12	James E. Simon Co./asphalt batch	c	f	10	10	10
13	Birdsall Sand & Gravel/concrete batch	in	e	8	10	11
14	Dakota Block Company/concrete block mfg.	c	f	2	2	2
15	L. G. Everist, Inc./gravel crushing	c	f	d	d	d
16	Aby's Feed and Seed/feed & grain	c	f	2	2	2
17	Hubbard Milling Company/feed & grain	c	f	33	33	33
	Total			5664	1823	2094

[a] Process emissions only, fugitive emissions accounted for separately.

[b] No new or proposed sources can currently be identified; data reflect projection of emissions from current known sources only.

[c] Compliance status unknown.

[d] Unknown.

[e] NEDS.

[f] South Dakota Department of Environmental Protection permit application.

The total particulate emissions from all identified point sources (17) in the analysis area in 1974 were 5,664 ton per year. This was approximately 46 percent of the total emissions in the analysis area. Note that these are process emissions only; source related fugitive emissions are accounted for separately under Area Source emissions.

The projected emissions for all point sources are also shown in Table 3-1. No detailed growth factors for the specific facilities existed; therefore, it was necessary to extrapolate based on the expected overall growth for the industries in general. It was assumed that the sources out of compliance in 1974 would employ emission reduction measures so that their entire facility would be in compliance by 1975. The allowable emissions for each particular point in each affected facility when in full compliance at the 1974 production level were then multiplied by the appropriate Bureau of Economic Analysis (BEA)[19] industry-wide growth factors to estimate 1980 and 1985 emissions. For the facilities presently in compliance, or whose status was undetermined, the 1974 emission rate was multipled by the BEA growth factors. This procedure, then, accounts for normal industry production growth among the current identified point sources. Overall, for the Rapid City analysis area, the projected 1980 and 1985 point source emissions, assuming full source compliance, demonstrate a 68 and 63 percent reduction, respectively, over 1974 levels.

Area Sources

Area source emissions and projections by source category on a county-wide basis (Pennington County only) were obtained from the Area Source Emission Inventory for South Dakota.[7] Table 3-2 summarizes these emissions. A detailed

Table 3-2. AREA SOURCE PARTICULATE EMISSIONS FOR PENNINGTON COUNTY[a]

Source category	Particulate emissions, ton/yr 1974	1980	1985
Fuel combustion			
Bituminous coal	1	1	1
Fuel oil, distillate	6	6	7
Fuel oil, residual	neg	neg	neg
Natural gas	17	18	19
Other fuels, LPG	7	7	8
, wood	5	5	6
Mobile sources			
Highway vehicles, gasoline	239	245	225
, diesel	52	70	78
Aircraft	neg	neg	neg
Rail locomotive	5	5	5
Off-highway vehicles, gasoline	7	7	7
, diesel	65	65	65
Combustion of solid waste			
Open burning	101	104	104
Incineration	12	12	12
Fugitive dust			
Unpaved roads	20,291	20,291	20,291
Paved roads	2,135	2,861	3,203
Agriculture (tilling and erosion)	4,648	4,648	4,648
Construction	153	174	190
Aggregate storage piles	neg	neg	neg
Total	27,744	28,519	28,869

[a] Area Source Particulate Emission Inventory for South Dakota.

description of the procedures used to estimate and project the area source emissions may be found in the above report.

In order to allocate the county-wide area source emissions (conventional only) into the ten grids comprising the Rapid City analysis area, the methodologies described in Volume 13 of the AQMA guidelines, Allocating Projected Emissions to Sub-county Areas,[8] were employed to assist in developing apportioning factors for each source category. The parameters used for apportioning these emissions are summarized in Table 3-3.

Emissions from the fugitive dust sources were based on the emission level parameters shown in Table 3-3. These parameters and related emission factors were developed through an on-site evaluation of the study area in November, 1975.[9]

The resulting emissions in Rapid City by grid (including point sources) for the three analysis years are presented in Tables 3-4, 3-5, and 3-6.* These tables are condensed summaries of the detailed grid emissions summaries and emission density estimates (Appendix B). It may be verified that conventional area sources account for approximately 1 percent of the total emissions in 1974, while fugitive dust sources comprise almost 53 percent. Since the point sources accounted for 46 percent of the total, the significant impact of the fugitive dust sources in this region is readily apparent. It is also significant that even though total

---

*Note that although grid emissions from conventional sources in Rapid City are directly proportional to Pennington County emissions (Table 3-2), fugitive emissions were developed by a microscale analysis and are, therefore, more accurate and not comparable or proportionate to county-wide emissions, which were developed from regional data. As a result, emissions from certain source categories (i.e., construction) may indeed exceed the total county-wide emissions for that source.

Table 3-3. APPORTIONING FACTORS BY SOURCE CATEGORY

Source category	Apportioning factor/ emission level parameters	Source of apportioning data
Conventional area sources		
Mobile sources		
Highway vehicles	miles of road (paved/unpaved)	County highway map and USGS maps
Off-highway vehicles	population/construction equipment use	County Business Patterns
Railroad	miles railroad track	County highway map and USGS maps
Stationary source fuel combustion	population	U.S. Census data
Combustion of solid wastes	no. of incinerators	S.D. DEP permit files
Fugitive dust sources		
Unpaved roads	miles unpaved road	[a]
Paved roads	miles paved road	[a]
Agriculture	acres of cropland	[a]
Construction	acres of construction	[a]
Unpaved shoulders	miles of road w/shoulders	[a]
Road sanding	miles of sanded road	[a]
Unpaved parking lots	acres of parking lots	[a]
Cleared/Storage areas	acres of cleared/storage areas	[a]
Gravel pits	acres of gravel pits	[a]
Railroad rights-of-way	miles railroad track	[a]
Aggregate storage	acres of storage areas	[a]
Railroad yards	acres of railroad yards	[a]
Playgrounds	acres of playgrounds	[a]
Grain elevators	no. of elevators	[a]

[a] An on-site evaluation was the predominant source of data for this source; no apportioning was required.

Table 3-4. PARTICULATE EMISSIONS BY GRID AND SOURCE CATEGORY IN THE ANALYSIS AREA, 1974

	Source category, ton/yr																		
Grid	Point source	Fuel combustion	Mobile sources	Combustion of solid waste	Unpaved roads	Paved roads	Agriculture	Construction	Unpaved shoulders	Road sanding	Unpaved parking lots	Cleared/Storage areas	Gravel pits	Railroad rights-of-way	Aggregate storage	Railroad yards	Playgrounds	Grain elevators	Total
1	976	2	1	neg	43	14			neg	1	1		1410	2	113				2563
2	1216	1	3	neg	14	70		102		5	1		47		94				1553
3	neg	3	5	1	23	66				5		neg					1		104
4	3104	2	7	2	120	22			1	2	4	8	2538	5	423	2			6240
5	8	3	12	2	38	42			1	3	1	1		2	19		neg		132
6	neg	3	11	1	14	94		64	neg	7	neg						10		204
7	325	5	17	2	74	110		224		8	neg			2	94		4		865
8	neg	3	8	1	101	90				7	2	2		6	19	4	1	4	248
9	35	5	9	2	11	68		19		5	1			3		6	1	11	176
10	neg	5	11	1	14	136			neg	10	3						1		181
Total	5664	32	84	12	452	712		409	2	53	13	11	3995	20	762	12	18	15	12266

Table 3-5. PARTICULATE EMISSIONS BY GRID AND SOURCE CATEGORY IN THE ANALYSIS AREA, 1980

	Source category, ton/yr																		
Grid	Point source	Fuel combustion	Mobile sources	Combustion of solid waste	Unpaved roads	Paved roads	Agriculture	Construction,	Unpaved shoulders	Road sanding	Unpaved parking lots	Cleared/Storage areas	Gravel pits	Railroad rights-of-way	Aggregate storage	Railroad yards	Playgrounds	Grain elevators	Total
1	129	2	1	neg	43	19			neg	1	1		1607	2	113				1918
2	300	1	3	neg	14	94		116		7	1		54		94				684
3	neg	3	5	1	23	88				7		neg					1		128
4	1264	2	7	2	120	29			1	3	4	8	2893	5	423	2			4763
5	10	3	13	2	38	56			1	4	1	1		2	19		neg		150
6	neg	3	12	1	14	126	--	73	neg	9	neg						10		248
7	85	5	18	2	74	147	--	255		11	neg			2	94		4		697
8	neg	3	9	1	101	121	--			9	2	2		6	19	4	1	4	282
9	35	5	10	2	11	91		22		7	1			3		6	1	11	205
10	neg	5	12	1	14	182			neg	13	3						1		231
Total	1823	32	90	12	452	953		466	2	71	13	11	4554	20	762	12	18	15	9306

Table 3-6. PARTICULATE EMISSIONS BY GRID AND SOURCE CATEGORY IN THE ANALYSIS AREA, 1985

	Source category, ton/yr																		
Grid	Point source	Fuel combustion	Mobile sources	Combustion of solid waste	Unpaved roads	Paved roads	Agriculture	Construction	Unpaved shoulders	Road sanding	Unpaved parking lots	Cleared/Storage areas	Gravel pits	Railroad rights-of-way	Aggregate storage	Railroad yards	Playgrounds	Grain elevators	Total
1	149	2	1	neg	43	21			neg	2	1		1748	2	113				2082
2	346	1	3	neg	14	105		126		8	1		58		94				756
3	neg	3	5	1	23	99				8		neg					1		140
4	1454	2	7	2	120	33			2	3	4	8	3147	5	423	2			5212
5	11	3	12	2	38	63			2	5	1	1		2	19		neg		159
6	neg	3	11	1	14	141		79	neg	11	neg						10		270
7	97	6	18	2	74	165		278		12	neg			2	94		4		752
8	neg	3	8	1	101	135				11	2	2		6	19	4	1	4	297
9	35	6	9	2	11	102		24		8	1			3		6	1	11	219
10	neg	6	11	1	14	204			neg	15	3						1		255
Total	2092	35	85	12	452	1068		507	4	83	13	11	4953	20	762	12	18	15	10142

emissions are forecast to reduce by 24 percent (1980) and 17 percent (1985) over 1974 levels, emissions from all area sources are expected to comprise 81 percent and 79 percent of the total in 1980 and 1985, respectively.

Area source emissions projection factors are consistent with those applied in the Area Source Emission Inventory.[7]

BASE YEAR AIR QUALITY AND MODEL VERIFICATION

Annual particulate concentrations measured at the four high volume sampling stations in Rapid City are shown in Appendix C (Table C-1).[10] Sites 7, 8, and 9 showed violations of the annual primary NAAQS for particulates in 1974 and 1975 (112 ug/m^3, 148 ug/m^3, and 344 ug/m^3 geometric means, respectively). Site 6, located at the Water Treatment Plant, was in violation of the secondary standard (61 ug/m^3). Sites 8 and 9 were installed in December, 1974 and January, 1975, respectively, so the measured concentrations at these sites reflect 1975 air quality, not the base year 1974. For the purposes of this analysis, the values must be assumed representative of 1974 air quality.

The prime basis for development of the emission density versus air quality relationship from which grid air quality could be predicted was through employment of the "microinventory" technique.[9] This technique was developed by PEDCo and applied to similar studies in other Region VIII states, demonstrating reasonably good accuracy and reproducibility in correlating quantified estimates of source emission strength with measured air quality.

The survey procedure employed to provide the best observation of overall site exposure was to ground survey, via automobile, the sampler stations and all probable sources of emissions within a 1.0 mile radius of each sampling site to identify the sources with primary impact on the samplers. Sources of fugitive dust and conventional point and area sources were located on the appropriate USGS map and labelled with pertinent data, such as size and boundaries, observed activity and operational characteristics, estimated emission rate, and any other important parameters. Two observers independently estimated and agreed upon parameters observed at each site to increase accuracy and completeness.

The high volume sampling station locations and survey areas are shown in Figure 3-4. On the basis of exposure, none of the sites are in a predominantly rural (agricultural source oriented) area. The 1.0 mile radius about each sampler was specified because that is approximately the range to which theoretical treatments (dispersion modeling) show that ground level sources will have a significant impact.

The survey data were converted into estimates of particulate emission density (ton/sq mi/yr) from the 3.14 square mile area (circle of 1.0 mile radius) by a three step procedure. First, all identified sources within each site area were listed and estimates of size in terms of emission parameters were made. Next, appropriate emission factors were applied to each source to calculate estimated annual emissions. Third, conventional area and point source emissions not accounted for by the survey were added to get total particulate emissions in each survey area.

The emission factors for the fugitive dust sources are summarized in Table D-1. Shown for comparison are those factors developed for similar studies by PEDCo in Nevada, Wyoming, and Kansas-Nebraska.[11] Variations are accounted for by differences in climate of the different geographic areas, i.e., wind speed, soil erosion parameters, and precipitation-evaporation indices. Appropriate methodologies for development of each factor were obtained from Compilation of

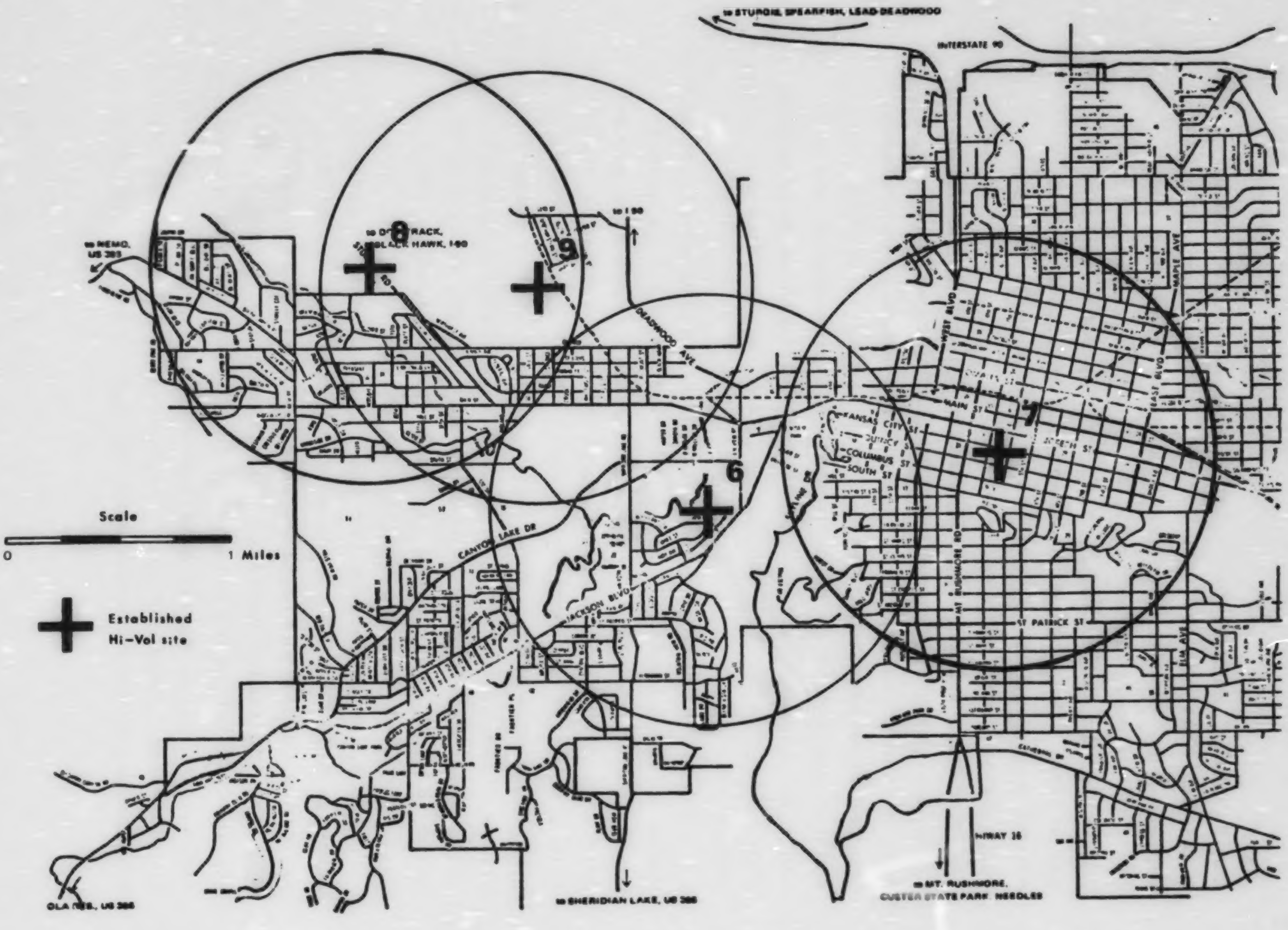

to STURGIS, SPEARFISH, LEAD-DEADWOOD
INTERSTATE 90
to NEMO, US 385
to O'NEIL PASS, BLACK HAWK, I-90
to I 90
8
9
6
7
DEADWOOD AVE
WEST BLVD
MAPLE AVE
EAST BLVD
MAIN ST
KANSAS CITY ST
QUINCY ST
COLUMBUS ST
SOUTH ST
ST JOSEPH ST
MT RUSHMORE RD
ST PATRICK ST
ELM AVE
CANYON LAKE DR
JACKSON BLVD
CATHEDRAL DR
HIWAY 16
to MT. RUSHMORE, CUSTER STATE PARK, NEEDLES
to SHERIDIAN LAKE, US 385
OLA RES., US 385
Scale
0
1 Miles
Established Hi-Vol site

Figure 3-4. Location of hi-vol sites and microinventory areas in Rapid City.

Air Pollutant Emission Factors (AP-42)[12] and from Development of Emission Factors for Fugitive Dust Sources.[13] Factors for those point sources for which no emission data were available in the state agency data files or in the NEDS system were based on those presented in AP-42.

Conventional area source emissions in the microinventory areas were not estimated by emission factors, but as a percentage of the respective total county emissions calculated for the categories included in the area source inventory. The categories were condensed, for summary purposes, into three general categories: stationary area source fuel combustion, mobile sources, and combustion of solid wastes. The percentages of county emissions were assumed to be the same as the percentages of the county's population contained in the microinventory areas.

Assuming then, that ground level emissions in the site survey areas are, in fact, directly proportional to air quality, the 1974/1975 annual geometric mean concentration for each sampler (in both Rapid City and Sioux Falls) and corresponding emission density were plotted (Figure 3-5). Using the eight valid data points, a linear regression analysis was performed to determine a line of best fit, which resulted in a "background" concentration of 20 ug/m^3 (zero emission density) and a correlation coefficient of 0.878. This correlation between estimated emission density and measured concentration is unusually high, but reveals a strong relationship.

Since the results obtained from this approach are reasonable, the empirical curve was used to determine air quality in the ten grids for the base year and future years from estimated emission density. The exact procedures (foregoing) for determining microinventory area emission density were employed to determine analysis grid emission density. Those summaries are presented in Appendix B.

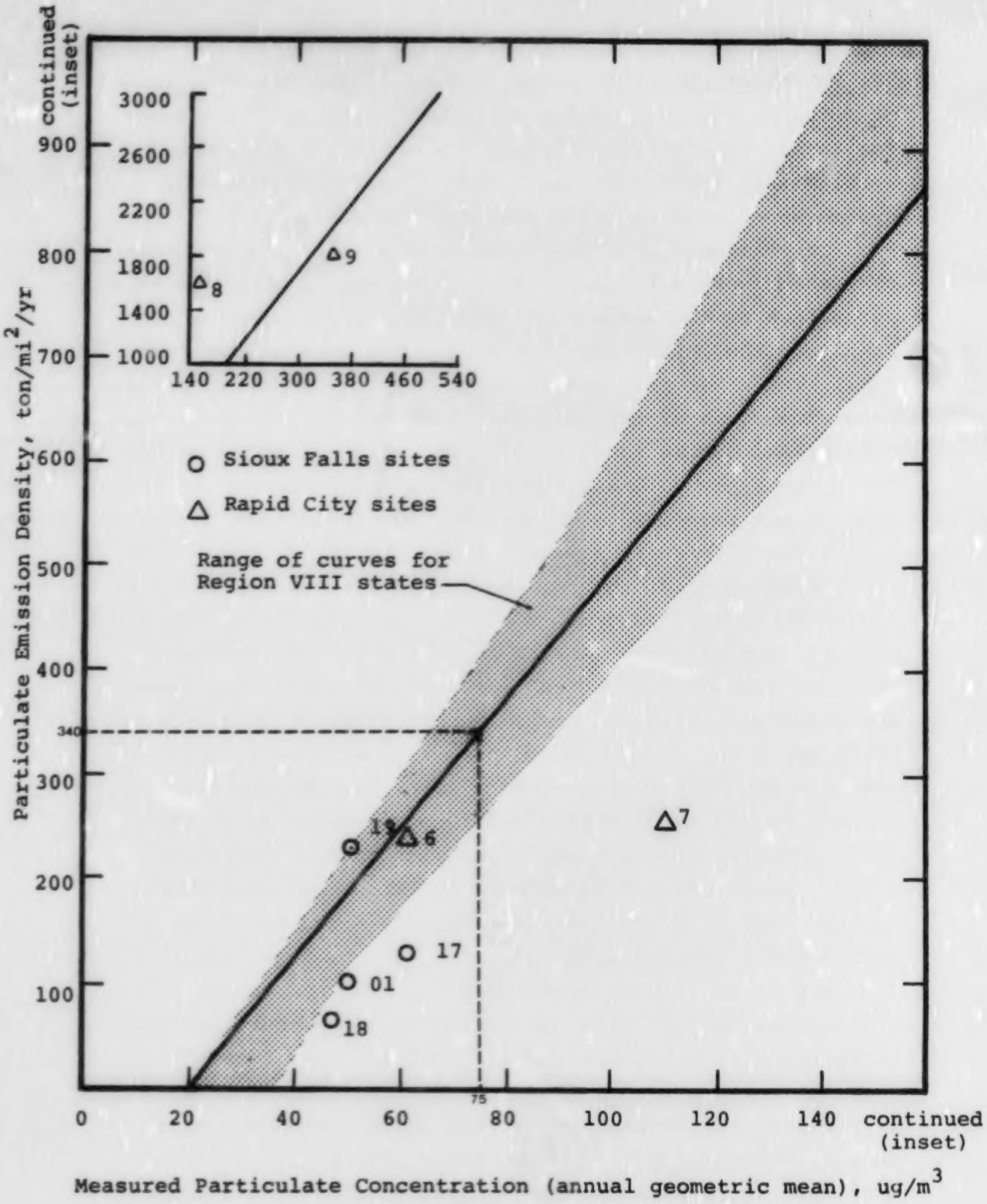


Figure 3-5. Particulate emission density versus measured air quality for South Dakota hi-vol sites.

PROJECTED AIR QUALITY

Particulate air quality was projected for the Rapid City analysis area using the same emission density-air quality curve developed for the microinventory areas and applied to the base year. Both base year and projected particulate concentrations are shown for each grid in Table 3-7.

These results indicate that the annual primary and secondary NAAQS for particulates were violated in the base year 1974 in grids 1, 2, 4, and 7 and can be expected to be exceeded in 1980 and 1985 in grids 1, 4, and 7, while the secondary standard only is violated in grid 2.

Analysis of the grid emissions tables in Appendix B can yield a reasonably accurate estimate of the relative contribution from each major source category for the grids in violation. Table 3-8 presents the source contribution to particulate loading in the affected grids. It is indicated that, in 1974, fugitive dust sources cause the greatest impact in grids 1 and 7, while grid 2 is primarily affected by the one point source contained therein and grid 4 receives equal impact from fugitive and point sources. Within the fugitive dust source category, unpaved roads, paved roads, gravel pits, construction, and aggregate storage cause the greatest impact. As a general rule, the percent contribution by fugitive dust sources increases through 1980 in grids 1, 4, and 7 as existing point sources are assumed to come into compliance. By 1985, fugitive dust can be expected to account for approximately 83 percent of the particulate loading in grids 1, 4, and 7.

Table 3-7. RAPID CITY PARTICULATE EMISSION DENSITY AND PREDICTED AIR QUALITY

Grid no.	Emission density, ton/sq mi/yr 1974	Emission density, ton/sq mi/yr 1980	Emission density, ton/sq mi/yr 1985	TSP concentration,[a] ug/m3 1974	TSP concentration,[a] ug/m3 1980	TSP concentration,[a] ug/m3 1985
1	1686	1262	1370	300	230	255
2	539	238	263	107	60	63
3	69	85	93	31	34	35
4	2798	2136	2337	480	375	410
5	171	195	206	47	53	54
6	64	78	85	30	32	34
7	443	357	386	92	78	80
8	86	97	102	34	36	37
9	147	172	184	43	47	50
10	58	74	82	29	32	33

[a] Expected annual geometric mean concentration.

Table 3-8. RAPID CITY SOURCE CONTRIBUTION TO GRIDS IN VIOLATION OF PARTICULATE NAAQS

	Percent contribution											
	Grid 1			Grid 2			Grid 4			Grid 7		
Source	1974	1980	1985	1974	1980[a]	1985[a]	1974	1980	1985	1974	1980	1985
Fugitive dust	62	93	93	21	56	54	50	73	72	60	84	83
Point source	38	7	7	78	44	46	50	27	28	38	12	13
Conventional area source	<1	<1	<1	<1	<1	<1	<1	<1	<1	3	4	4

[a] Exceeds secondary NAAQS in 1980 and 1985.

4. SIOUX FALLS AQMA

ANALYSIS AREA

The Sioux Falls AQMA was designated for suspended particulates due to its potential to exceed the NAAQS within the next ten years because of expected population growth and accompanying urban expansion. The AQMA consists of Minnehaha and Lincoln counties, which also form an SMSA. Sioux Falls is the largest urban area in South Dakota.

The two-county AQMA is located in the southeastern portion of the state (Figure 4-1). It has a land area of approximately 1,400 square miles, consisting primarily of gently rolling terrain. The Big Sioux River flows through the area from north to south, with the river valley bisecting Minnehaha County and forming the eastern boundary of Lincoln County. Sioux Falls is the only large city in the AQMA and is located approximately at its centroid. Within a 100 mile radius of Sioux Falls, the terrain slopes upward 300 to 400 feet to the north and northwest and slopes downward 200 to 300 feet to the southeast. There is little change in elevation in the remaining directions. To the east, about 7 to 15 miles from Sioux Falls, the AQMA is bordered by Minnesota and Iowa.

The terrain characterizing metropolitan Sioux Falls is generally flat, with a gentle sloping rise extending to the northeast from the center of town. The major industrial concentration lies along the Big Sioux River Valley extending north-south through the eastern portion of town. Two power plants are located northeast of town along the Brandon Road.

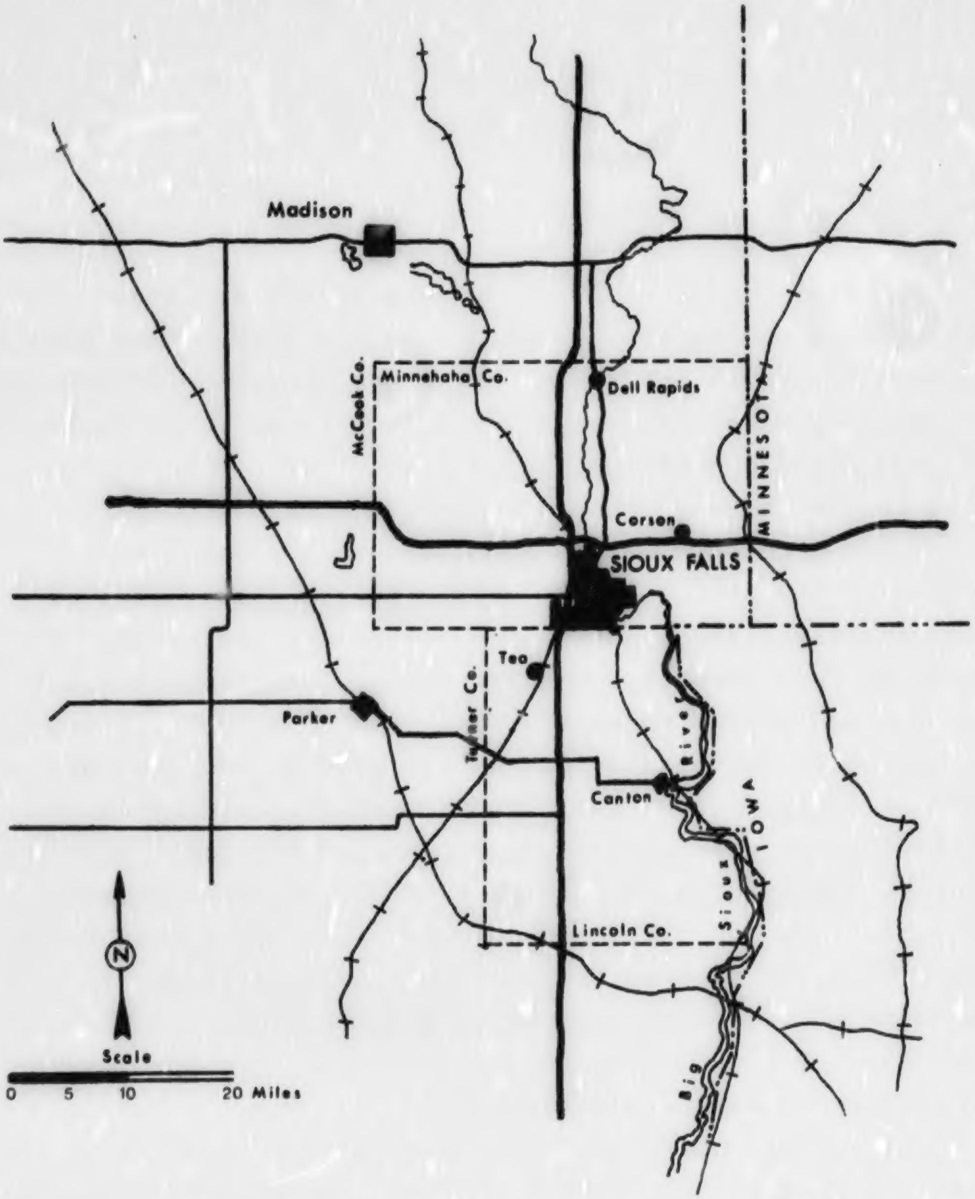

Madison
Minnehaha Co.
McCook Co.
Dell Rapids
Carson
SIOUX FALLS
MINNESOTA
Tea
Parker
Turner Co.
Canton
River
IOWA
Sioux
Big
Lincoln Co.
N
Scale
0
5
10
20 Miles

Figure 4-1. Sioux Falls AQMA.

The estimated 1974 population of the AQMA was 122,000.[14] That for Sioux Falls alone was 76,000, about 63 percent of the total. The surrounding towns in the AQMA are not large--Colton, Brandon, Dell Rapids, and Canton had 1973 populations of from 629 to 2,635. Current population projections[14] indicate that the two counties will increase in population an average of 1.1 percent per year to 1985, when the population is forecast to be 136,300. The actual modeling analysis area was designed with boundaries closely coincidental with those for the Sioux Falls Transportation Planning Process--Traffic Assignment Zone Study Area.[15] This area contained 93,540 total population in 1974, 77 percent of the AQMA population.

The Southeastern Council of Governments indicated that several large subdivisions are being developed south and east of Sioux Falls. Most industrial development is taking place north of the city. Unfortunately, no detailed quantitative data were provided to permit realistic estimates of urban expansion to be made.

In order to maintain the degree of resolution necessary to accurately locate concentration gradients with the atmospheric dispersion model, the entire two-county AQMA cannot be efficiently modeled as a single entity. To include an area of some 1,400 square miles, receptor sites in the model would have to be spaced at unacceptably large intervals or computer running time would be prohibitive if a close receptor spacing were used. Therefore, a smaller analysis area which should encompass the points of highest ambient concentration in the AQMA has been specified. This area is depicted in Figure 4-2. Most existing point sources of significant size, with the exception of some grain elevators, quarrying operations, etc. in the outlying towns, are located in this area. It is not expected at this time that any of these outlying population centers will present a significant potential for growth by 1985.

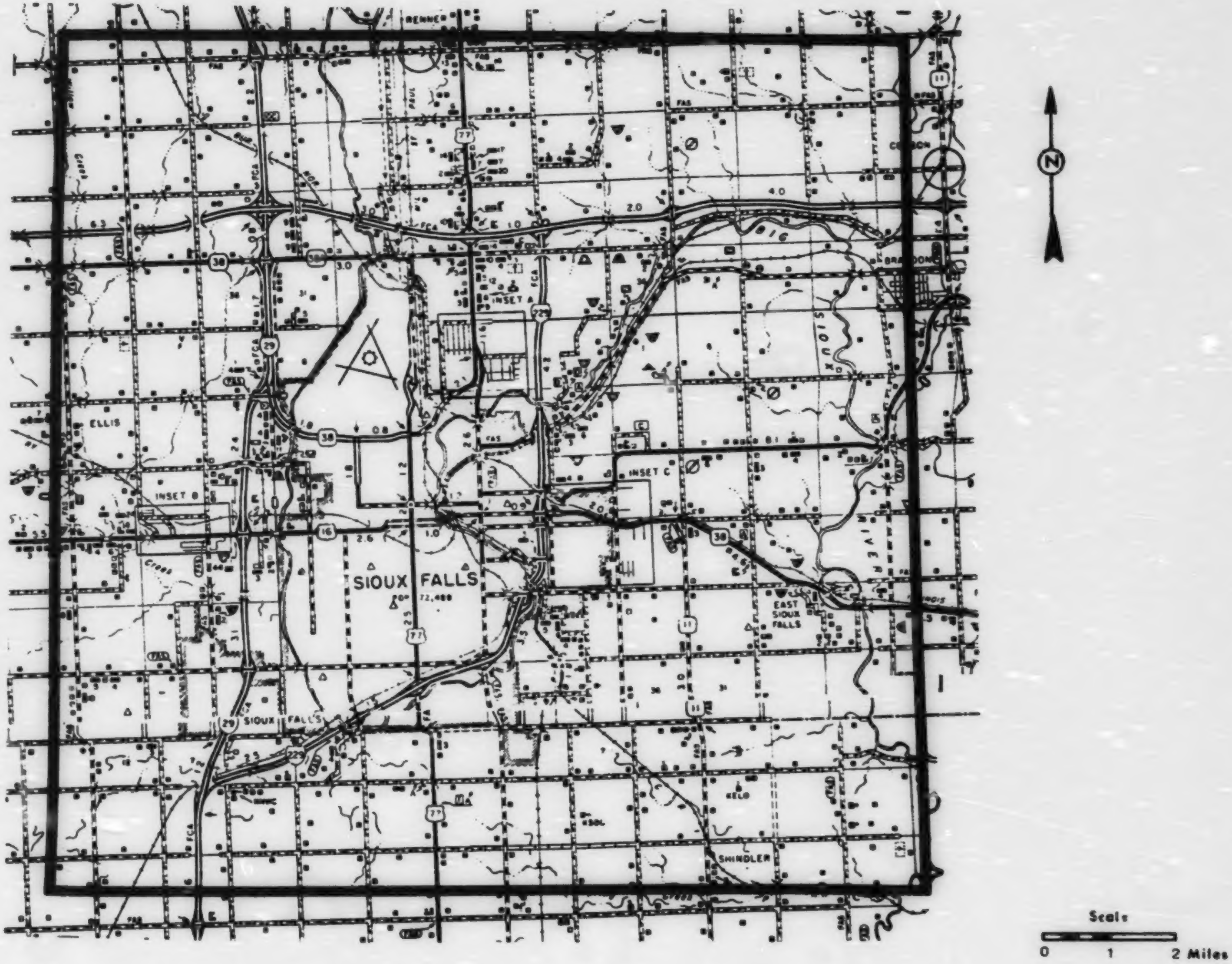

N
RENNER
CORSON
BRANDON
BIG
SIOUX
RIVER
INSET A
INSET B
INSET C
ELLIS
SIOUX FALLS
72,488
EAST SIOUX FALLS
KELO
SHINDLER
77
38
29
229
16
11
Scale
0
1
2 Miles

Figure 4-2. Sioux Falls AQMA modeling area.

METHODOLOGY

The AQMA analysis for suspended particulate is based on the use of regional dispersion modeling to predict ambient concentrations throughout the analysis area in the base year and two projection years for comparison with air quality standards. The methods used in the analysis are consistent with those described in the EPA guideline series for air quality maintenance planning and analysis. Volume 12 of the guidelines, Applying Atmospheric Simulation Models to Air Quality Maintenance Areas,[16] was used to review available models for application in the Sioux Falls AQMA.

Modeling

The AQDM[4] and CDM[5] were introduced in Chapter 3 as being capable of predicting annual average pollutant concentrations in a regional analysis area. Although CDM is a second generation multiple source model and includes some improvements over AQDM, it was excluded since it required meteorological data in day-night STAR program format.

Meteorological data obtained from the National Weather Service (NWS) for Sioux Falls were summarized in regular STAR program format, the required input for AQDM. Therefore, AQDM, which estimates annual mean and maximum concentrations at given receptor locations for both point and area sources, was selected. The AQDM is applicable to flat or rolling terrain.

The predicted concentrations can be calibrated by comparison with concentrations measured at sites within the area being modeled. The slope of the line of best fit between measured and predicted concentrations is used to correct for persistent over- or underprediction and the correlation coefficient provides an estimate of the accuracy of the simulation model.

The following input data are required for AQDM:

Description	Format
Source locations	UTM coordinates
Stack parameters	Stack height and diameter, exit temperature and flow rate (or velocity)
Meteorology	Joint frequency distribution of 16 wind directions, 6 wind speeds, and 5 stability classes
Receptor locations	UTM coordinates
Background concentration	Annual arithmetic mean
Emission rates	Tons per year

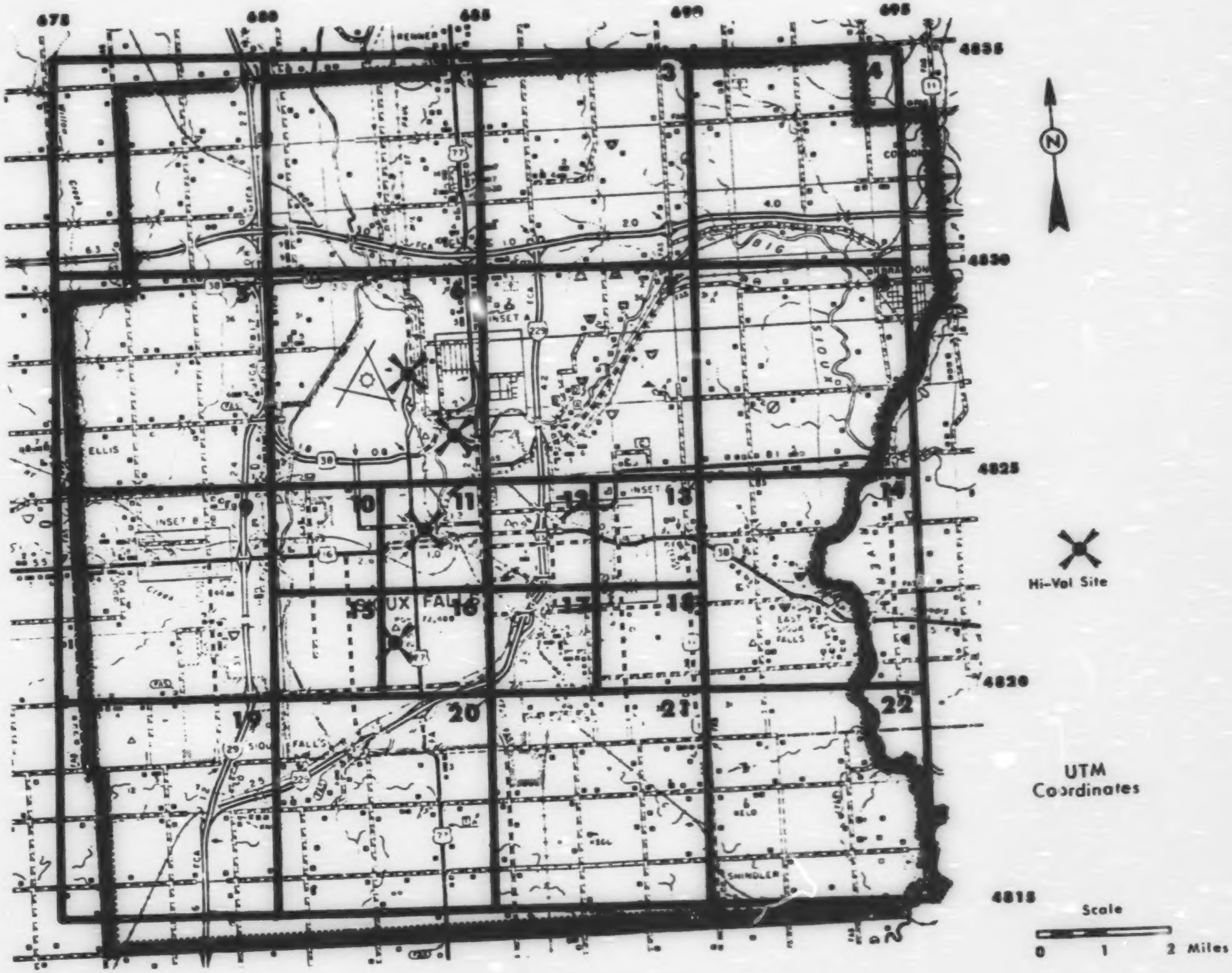
Each of these data inputs are discussed in sections that follow.

In addition, a short-term analysis evaluating compliance with the 24-hour TSP standard was conducted. This was based on the empirical mathematical model developed by Larsen and predicts the 24-hour maximum concentrations experienced at the four hi vol sites.

Location of Sources

The Sioux Falls area was subdivided into a system of 22 grids of non-uniform size in order to accommodate nonuniform development densities and obtain better spatial resolution. Figure 4-3 depicts this grid system. County-wide area source emissions were calculated and apportioned to the grids accordingly.

The locations of major existing point sources in the AQMA are shown in Figure 4-4. The UTM coordinates for the existing sources were obtained from NEDS listings and checked by locating the sites on USGS quadrangle maps. No


675
680
685
690
695
4835
4830
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SIOUX FALLS
BIG SIOUX RIVER
EAST SIOUX FALLS
ELLIS
INSET A
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SHINDLER
Hi-Vol Site
UTM
Coordinates
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0
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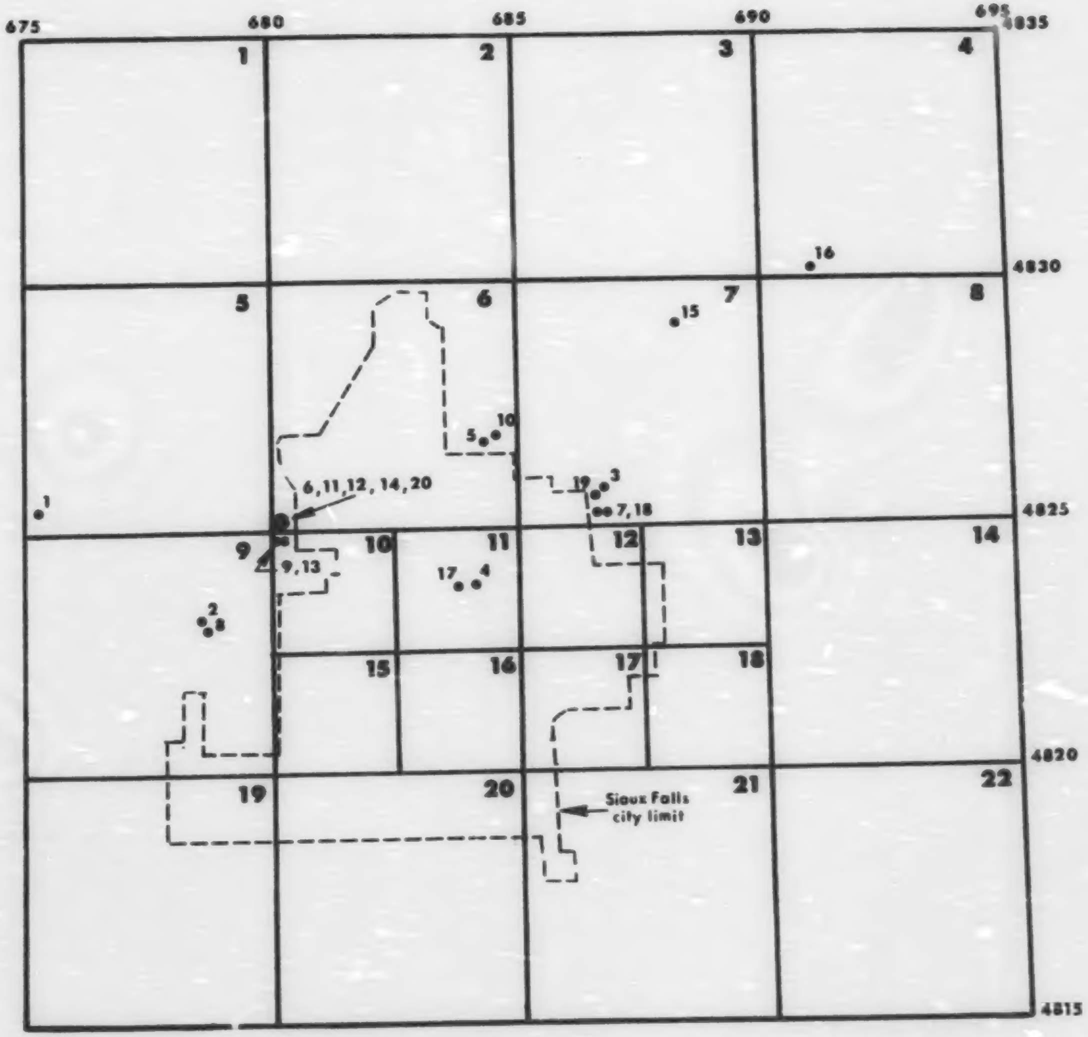
Figure 4-3. Sioux Falls analysis area; area source grid system.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Sioux Falls
city limit

Figure 4-4. Sioux Falls point source locations.

new or proposed sources were identified or located due to the unavailability of information. Complete source identification, as well as UTM coordinates and emission and stack data for each source are listed by source in Minnehaha County in Appendix A (Table A-1). The actual sources in the modeling area, as well as the actual data parameters input to AQDM, are referenced to Figure 4-4 by the source numbers in the listing in Table A-2. Point sources for Lincoln County do not appear therein because none are located in the Sioux Falls modeling area. They consist mainly of small grain elevators, fertilizer plants, and concrete products companies located in the outlying towns.

Stack Parameters

Insofar as possible, stack parameters were obtained from NEDS reports and are listed in Appendix A. For quite a few sources however, the requisite data were missing and it was necessary to make assumptions. Table 4-1 lists the stack parameters used for these sources. For the Pathfinder and Lawrence power plants, complete data were obtained from NEDS, source summaries, and permit applications, and assumptions were unnecessary.

Meteorology

The primary meteorological input data for AQDM--the joint frequency distribution of six wind speed classes, 16 wind directions, and five stability classes in the STAR program format--was available from the Sioux Falls NWS station for the year 1974 (eight observations per day). The station is located at Joe Foss Field. There are no recorded annual mixing heights for this station, so Holzworth[17] isopleths were used to determine an average afternoon annual

Table 4-1. SOURCE STACK PARAMETERS

Source type	Stack parameter[a]			
	Ht, ft	Dia, ft	Vel, ft/sec	Temp, °F
Grain elevators	10-20	5.0	1.0	77.0
Fertilizer plant	30	5.0	1.0	77.0
Feed mills	200	10.0	1.0	77.0
Asphalt batch plants	20-50	10.0	5.0	300.0
Concrete batch plants	5-20	10.0	5.0	77.0
Sand plant	5	5.0	5.0	77.0
Rock crushing	20	10.0	5.0	77.0

[a] assumed values input to AQDM.

mixing height of 1,300 meters. The data indicate that the 1974 annual average wind speed was 11.6 mph and resultant wind direction was from the west (270°). Therefore, these data were assumed representative of the area for the base year and future analysis years.

Receptor Locations

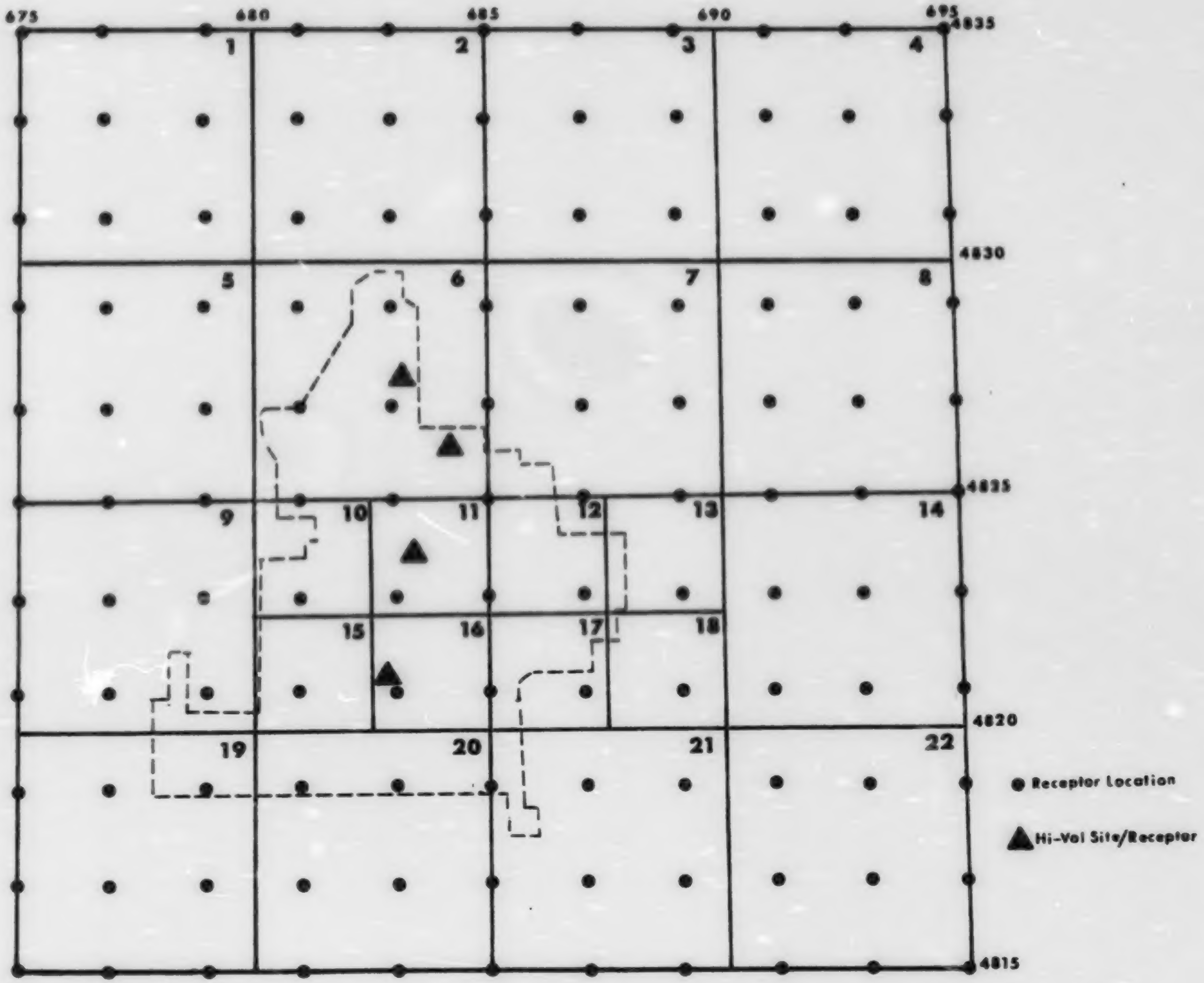
The AQDM permits the user to input a rectangular array of receptors and up to 12 special receptors. For the Sioux Falls analysis area, an array was specified so as to place a receptor at each corner of a 2 km by 2 km grid. This array, shown in Figure 4-5, is superimposed over the area source grids.

Only four special receptors were specified for the area--one at each high volume sampling site--so that predicted and measured concentrations could be compared. This design resulted in a total of 125 receptors spaced throughout the 20 km by 20 km area.

Background Air Quality

Background concentration is that portion of measured ambient pollutant levels that cannot be reduced by controlling emissions from local man-made sources. For SO_2 and NO_x, background is usually considered to be negligible. For particulate, the non-reducible fraction may originate from long-range transport, natural sources such as windblown dust and biological debris, and atmospheric aerosol formation.

The method specified in the Federal regulations (Section 51.13c)[1] for estimating particulate background is to use the concentration measured at a nonurban site in or near the study area that is unaffected by nearby emission sources. In Sioux Falls, all four of the high volume sampler sites would be characterized as urban with 1974 measured annual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● Receptor Location
▲ Hi-Vol Site/Receptor

Figure 4-5. Sioux Falls analysis area; receptor locations.

geometric mean concentrations from 47 to 61 ug/m.[3] It is evident that none of these sites could be considered as reflecting background air quality. When the South Dakota SIP was written in 1972, there were no specific background measurements available, so a value of 18 ug/m^3, measured at a nonurban site in the Black Hills, was used in standard rollback calculations. This value, however, was considered inappropriate for use in a detailed analysis such as this in that there are vast differences in the terrain, climatology, and wind erosion potential between the Black Hills and Sioux Falls.

The sites at Brookings, Mitchell, and Yankton, South Dakota had recorded 1974 annual geometric mean concentrations of 41, 52, and 76 ug/m^3, respectively. A site in georural Fargo, North Dakota recorded an annual mean (geometric) of 34 ug/m^3.[18] Fargo is due north of Sioux Falls and has similar exposure, terrain, and climatological patterns. Actual background in Sioux Falls is probably somewhere between the values recorded in Brookings and Fargo. By subtracting the source impact indicated by the uncalibrated AQDM model at the airport site (the most nonurban site in Sioux Falls), an estimate of local background was obtained. The value for source impact was 12 ug/m^3 (geometric), resulting in an estimated background concentration of (47 - 12) = 35 ug/m^3 (geometric). This value seems entirely reasonable and agrees closely with the value used for Fargo.

EMISSIONS--BASE YEAR AND PROJECTED

Following the same procedures employed for the Rapid City analysis, pollutant emissions were tabulated for the two major categories of point sources and area sources (conventional and fugitive origin).

Point Sources

Point source emission data and identification parameters for the base year 1974 were obtained from NEDS reports supplied by PES, Inc. Emissions estimates for those sources for which the NEDS data were incomplete were made from data on South Dakota DEP permit applications and variance requests by employing appropriate emission factors. As with Rapid City, this less accurate estimating procedure was necessary for many sources due to the lack of sufficiently accurate and complete NEDS data. A listing of the point sources with their emissions, compliance status, and data source is presented in Table 4-2. Detailed source specific data may be obtained by cross-referencing the selected map point ID number (Figure 4-4) with the listing in Tables A-1 and A-2.

The total particulate emissions from all identified point sources (20) in the modeling area in 1974 were 1,169 tons, approximately 11 percent of the total.

The projected emissions from all point sources are also shown in Table 4-2. Sources were assumed to be in compliance by 1975. Detailed growth factors for each specific facility were unavailable, so projections were made based on expected industry growth in the area as reflected in BEA projected earnings by industry.[19] For feed/grain elevators, feed mills, and fertilizer plants, the projected earnings for all of agriculture were used to develop growth factors and project emissions. For asphalt batching and concrete batching operations, growth factors were developed based on projected earnings for all contract construction.

The Northern States Power Company's (NSP) Pathfinder Generating Plant is presently in compliance with applicable particulate emissions regulations.

It has previously been proposed to alternatively employ gas fired boilers presumably to come into compliance with NO_x regulations. With this change, particulate emissions

Table 4-2. POINT SOURCE EMISSIONS IN THE SIOUX FALLS MODELING AREA

Map point ID no.	Source name/type	Compliance status	Data source	Particulate emissions,[a] ton/yr 1974	1980[b]	1985[b]
1	Farmers Union Central Exchange/fertilizer	c	f	36	42	44
2	Golden Sun Feeds/Feed and grain	c	f	40	47	49
3	Pure Plant Food International/fertilizer	c	f	1	1	1
4	Zip Feed Mills/Feed and grain	c	f	1	1	1
5	City of Sioux Falls/asphalt batching	c	f	30	38	45
6	Concrete Materials Co.[d]/concrete batch	c	f	1	1	2
7	Eagle Materials Co.[d]/concrete batch	c	f	4	5	6
8	Gage Bros. Concrete Products/concr. batch	c	f	0	1	2
9	Sweetman Construction Co./constr.	in	e	3	4	5
10	Traub Silo Co./concrete batch	c	f	0	1	2
11	Concrete Materials Co.[d]/asphalt batch	in	e	35	44	53
12	Concrete Materials Co.[d]/asphalt batch	out	e	181	64	76
13	Sweetman Construction Co./constr.	in	e	7	9	11
14	Sweetman Construction Co./constr.	in	e	2	3	3
15	Northern States Power Co./Pathfinder Plt.	in	f	48	55	63
16	Northern States Power Co./Lawrence Plt.	out	f	388	125	144
17	Unknown/food processor-confectionary	in	e	94	111	115
18	Concrete Materials Co.[d]/sand plant	in	e	29	37	44
19	Eagle Materials Co.[d]/open pit mining	c	f	0	1	2
20	Concrete Materials Co.[d]/gravel	out	e	269	240	285
	Total			1169	830	953

[a] Process emissions only, fugitive emissions accounted for separately.

[b] No new or proposed sources can currently be identified; data reflect projection of emissions based on current levels only.

[c] Compliance status unknown.

[d] Division of Sweetman Construction Company (as of 4/1/76).

[e] NEDS.

[f] South Dakota Air Pollution Control Commission permit application.

are estimated to be 40 tons per year in 1985.[20] Nevertheless, emissions were projected to 1985 based on the 1974 level (48 ton/yr) because the source is in compliance and has been assumed to experience a normal rate of growth in future years.

The NSP Lawrence Plant, based on current emission levels (388 ton/yr), must be derated by approximately 68 percent in order to meet applicable particulate regulations. This approach has been seriously considered by company officials and regulatory officials as being the most viable option at least for the near future. It has been proposed that with the construction of a new coal gasification facility, 1985 emissions should equal approximately 25 tons per year.[20] Again, because the status of these proposals is not currently known, emissions have been projected to 1985 based on the reduction achieved by derating and applying a factor to account for normal growth.

Based on the foregoing assumptions for point sources then, it may be noted that emissions therefrom are expected to decrease slightly (i.e., 19 percent) by 1985 to 953 tons.

Area Sources

Area source emissions and projections by source category on a county-wide basis (Minnehaha/Lincoln Counties) were obtained from the Area Source Emission Inventory for South Dakota.[7] Table 4-3 tabulates these emissions. A detailed accounting of the procedures used to estimate and project the area source emissions may be found in the above report.

In order to allocate the county-wide area source emissions into the 22 grids comprising the analysis area, the methodologies described in Volume 13 of the AQMA Guidelines[8] were employed to assist in developing apportioning factors for each source category. These parameters are presented in Table 4-4.

Table 4-3. AREA SOURCE PARTICULATE EMISSIONS FOR MINNEHAHA AND LINCOLN COUNTIES

Source category	Particulate emissions, ton/yr 1974	1980	1985
Fuel combustion			
Bituminous coal	2	2	2
Fuel oil, distillate	35	41	42
Fuel oil, residual	neg	neg	neg
Natural gas	31	33	35
Other fuels, LPG	12	13	13
, wood	6	6	7
Mobile sources			
Highway vehicles, gasoline	491	512	537
, diesel	87	117	148
Aircraft	19	23	27
Rail locomotive	3	3	3
Off-highway vehicles, gasoline	22	23	24
, diesel	139	143	147
Combustion of solid waste			
Open burning	neg	neg	neg
Incineration	14	14	14
Fugitive dust			
Unpaved roads	61,679	47,577	33,474
Paved roads	4,198	5,633	7,135
Agriculture (tilling and erosion)	24,174	24,174	24,174
Construction	70	94	109
Total	90,982	78,408	65,891

Table 4-4. APPORTIONING FACTORS BY SOURCE CATEGORY

Source category	Apportioning factor/ emission level parameters	Source of apportioning data
Conventional area sources		
Mobile sources		
Highway vehicles	miles of road (paved/unpaved)	County highway map
Off-highway vehicles	acres agricultural land	USGS maps
Railroad	miles railroad track	County highway map and USGS maps
Aircraft	point allocation	N/A
Stationary source fuel combustion	no. of dwelling units	[a]
Combustion of solid wastes	no. of incinerators	S.D. DEP file data
Fugitive dust sources		
Unpaved roads	miles unpaved road	County highway map and USGS maps
Paved roads	miles paved road	County highway map and USGS maps
Agricultural tilling	acres agricultural land	USGS maps
Construction	acres open land and commercial development areas	City building permit office

[a] Sioux Falls Transportation Planning Process, Traffic Assignment Zone Study.

Tables 4-5, 4-6, and 4-7 summarize the emissions by grid (area and point source) for the three analysis years. Throughout the analysis period, total emissions should decline about 10 percent, from 10,441 tons per year in 1974 to 9,405 tons per year in 1985. This is due primarily to a 9 percent decrease in the area source contribution, mainly fugitive dust from unpaved roads. During this period, point sources are shown to decrease by about 18 percent as sources come into compliance and experience normal growth. The area source/point source mix remains relatively constant over the years, with area sources comprising about 89 percent of the total in 1974 and close to 90 percent in 1985.

BASE YEAR AIR QUALITY AND MODEL VERIFICATION

The sampling stations, judged by their site location and relative exposure profiles, seem to provide a reasonably unbiased indication of baseline air quality in the Sioux Falls region. The installation of a station appropriately located to indicate a reasonable estimate of background air quality would round out the monitoring efforts currently underway.

The airport and wastewater treatment plant stations were installed in 1972 and yielded a continuous year of data for 1974 for use in this analysis. The station at Augustana College was installed in February of 1975, so annual averages for 1974 were not available. The 1975 data were, therefore, assumed representative of 1974 for purposes utilized herein. The City Hall station is an EPA NASN station for which 1974 annual averages were available. All of the sampling data for the four stations show concentrations to be below the annual and short-term averages for the primary and secondary particulate standards, with the exception of the wastewater treatment plant station, which recorded an annual geometric mean of 61 ug/m^3 and a 24-hour maximum of 153 ug/m^3 (see Appendix C).

Table 4-5. PARTICULATE EMISSIONS BY GRID AND SOURCE CATEGORY IN THE SIOUX FALLS MODELING AREA, 1974

	Source category, ton/yr											
Grid	Fuel combustion	Highway motor vehicles	Aircraft	Railroad	Off-highway vehicles	Agriculture	Incineration	Unpaved roads	Paved roads	Construction	Point source	Total
1		7		---- negligible emissions ----	2	191		292	84			575
2	1	4			2	191		261	45			503
3		5			2	191		292	50			539
4		5			2	191		326	50		388	962
5		7			2	191		390	65		36	690
6	5	13	19		1	72		129	229		518	986
7	2	8			1	77		326	101		82	597
8	neg	5			1	143		261	50			461
9	3	7			1	120		322	80		40	573
10	7	7					2		131	12	10	169
11	13	12					2		229	12	95	363
12	9	9					2		177	12		209
13	2	3				37		58	49			148
14		5			2	191		356	39			593
15	6	8					2		142	12		170
16	10	12					2		224	12		260
17	2	5					2		90	12		111
18	1	2				48		58	32			141
19	5	3				108		481	34			630
20	3	2			1	161		358	24			549
21	2	2			1	215		411	15			645
22	neg	1			1	215		342	7			567
Total	71	132	19	neg	19	2342	12	4663	1947	70	169	10441

Table 4-6. PARTICULATE EMISSIONS BY GRID AND SOURCE CATEGORY IN THE SIOUX FALLS MODELING AREA, 1980

	Source category, ton/yr											
Grid	Fuel combustion	Highway motor vehicles	Aircraft	Railroad	Off-highway vehicles	Agriculture	Incineration	Unpaved roads	Paved roads	Construction	Point source	Total
1		8		negligible emissions	2	191		201	112			514
2	1	5			2	191		180	60			438
3		6			2	191		201	67			467
4		6			2	191		225	67		125	615
5		7			2	191		269	87		42	598
6	5	14	23		1	72		89	307		391	902
7	2	9			1	77		225	135		99	548
8	neg	5			1	143		180	67			397
9	3	7			1	120		222	108		48	509
10	8	8					2		175	15	13	220
11	14	13					2		307	15	112	463
12	9	10					2		237	15		273
13	2	3				37		40	65			147
14		6			2	191		246	52			496
15	7	8					2		190	15		222
16	11	13					2		300	15		341
17	3	5					2		120	15		144
18	1	2				48		40	43			134
19	5	3				108		423	46			585
20	3	2			1	161		315	33			515
21	2	2			1	215		361	20			601
22	neg	1			1	215		301	10			528
Total	76	143	23	neg	19	2342	12	3518	2608	90	830	9657

Table 4-7. PARTICULATE EMISSIONS BY GRID AND SOURCE CATEGORY IN THE SIOUX FALLS MODELING AREA, 1985

	Source category, ton/yr											
Grid	Fuel combustion	Highway motor vehicles	Aircraft	Railroad	Off-highway vehicles	Agriculture	Incineration	Unpaved roads	Paved roads	Construction	Point source	Total
1		8		---- negligible emissions ----	2	191		111	144			456
2	1	5			2	191		99	77			375
3		6			2	191		111	87			396
4		6			2	191		124	87		144	553
5		8			2	191		148	112		44	505
6	5	16	27		1	72		49	394		466	1030
7	2	10			1	77		124	173		116	503
8	neg	6			1	143		99	87			336
9	3	8			1	120		123	138		51	444
10	8	8					2		225	17	16	276
11	14	15					2		394	17	116	558
12	10	11					2		305	17		345
13	2	4				37		22	83			148
14		6			2	191		135	67			401
15	7	9					2		244	17		279
16	12	14					2		385	17		430
17	3	6					2		154	17		182
18	1	3				48		22	55			128
19	6	3				108		365	55			537
20	3	2			1	161		272	39			478
21	3	2			1	215		312	24			556
22	neg	2			1	215		260	12			489
Total	80	158	27	neg	19	2355	12	2376	3341	102	953	9405

The AQDM model was first run for the base year 1974 so that the modeling results could be verified by comparison with measured concentrations. The model predicts annual arithmetic concentrations at all specified receptor sites, subject to the constraints and input data explained in previous sections of this chapter. Model-predicted values are compared with measured values in Table 4-8. Linear regression analysis between measured and predicted values yielded a slope of -0.2 and a y-intercept of 61.7 for the line of best fit, and a correlation coefficient of -0.04. Ideally, the slope and correlation should approach 1.0 and the y-intercept should be near zero when background has been included in the predicted concentrations. The slope of the line of best fit can be used to correct for persistent over- or underprediction (calibration).

While the linear regression values indicate that the model is not very accurate, review of the data pairs shows that the model was within at least 1 ug/m^3 of the measured value in all but one case. There are some limitations on the accuracy of any model that would be inherent in the input data for this analysis area:

- The concentrations due to source emissions are much less than background, which was assumed to be constant throughout the analysis area. Small variations in actual background in different parts of the AQMA would have a strong influence on the total measured concentrations and on the resulting correlation between predicted and measured concentration.
- The majority of particulate emissions are from fugitive dust sources which, by their nature, are difficult to quantify or to locate accurately.

Table 4-8. COMPARISON OF MODEL-PREDICTED AND MEASURED POLLUTANT CONCENTRATIONS IN THE SIOUX FALLS AQMA ANALYSIS AREA, 1974

Receptor site	Predicted annual geometric mean,[a] ug/m^3	Measured annual geometric mean, ug/m^3
Joe Foss Field	47	47
Wastewater Treatment Plant	48	61
City Hall	50	50
Augustana College	49	50

[a] Includes background concentration of 35 ug/m^3 (geometric).

Also, differences in magnitude between data pairs, which may not appear large in a cursory analysis, cause an extreme loss in regression sensitivity when only four data sets are used.

In view of the reasonable values obtained in spite of the aforementioned limitations, the AQDM model has been applied uncalibrated to predict future particulate concentrations in the analysis area.

Prior to plotting the predicted particulate concentrations on a map of the analysis area, the values were converted from annual arithmetic to annual geometric means so that they could be compared directly with the applicable primary and secondary standards of 75 and 60 ug/m^3, respectively. This was accomplished by use of the following equation relating the two measures:

$$\frac{\text{arith. mean}}{\text{geom. mean}} = e^{1/2 \ln^2 \text{SGD}} \qquad \text{(eq.1)}$$

where SGD = standard geometric deviation

Standard geometric deviations of the sampling data at the four stations varied from 1.56 to 1.85. Since background is such a large portion of the predicted concentrations at all the receptors, the SGD of 1.65 from the airport site (the most rural site, and the one from which the background estimate was derived) was assumed to be representative for all locations. By solving equation 1 above for an SGD of 1.65, it can be determined that the geometric mean is 0.882 of the predicted arithmetic mean at a receptor.

This correction factor having been applied to the predicted arithmetic concentrations, the background concentration of 35 ug/m^3 (geometric) was added to complete the conversion.

Table 4-9 summarizes the predicted source contributions (in ug/m^3 and percent) from the five largest contributing point and area source to the perceived concentrations at the five maximum receptors in 1974. Figure 4-6 shows the locations of the five maximum receptors for 1974, 1980, and 1985. It is predicted that an average of 59 percent of the perceived TSP loading at the five maximum receptors will be caused by the 10 point and area sources indicated. All point sources account for approximately 3 percent of the concentrations at the five maximum receptors, while all area sources are responsible for about 69 percent of the loading.

The isopleth showing predicted 1974 concentrations is presented in Figure 4-7. It may be noted that concentrations approach the secondary standard, although areas of steep gradients are not indicated, which would point out a severe localized pollution problem.

PROJECTED AIR QUALITY

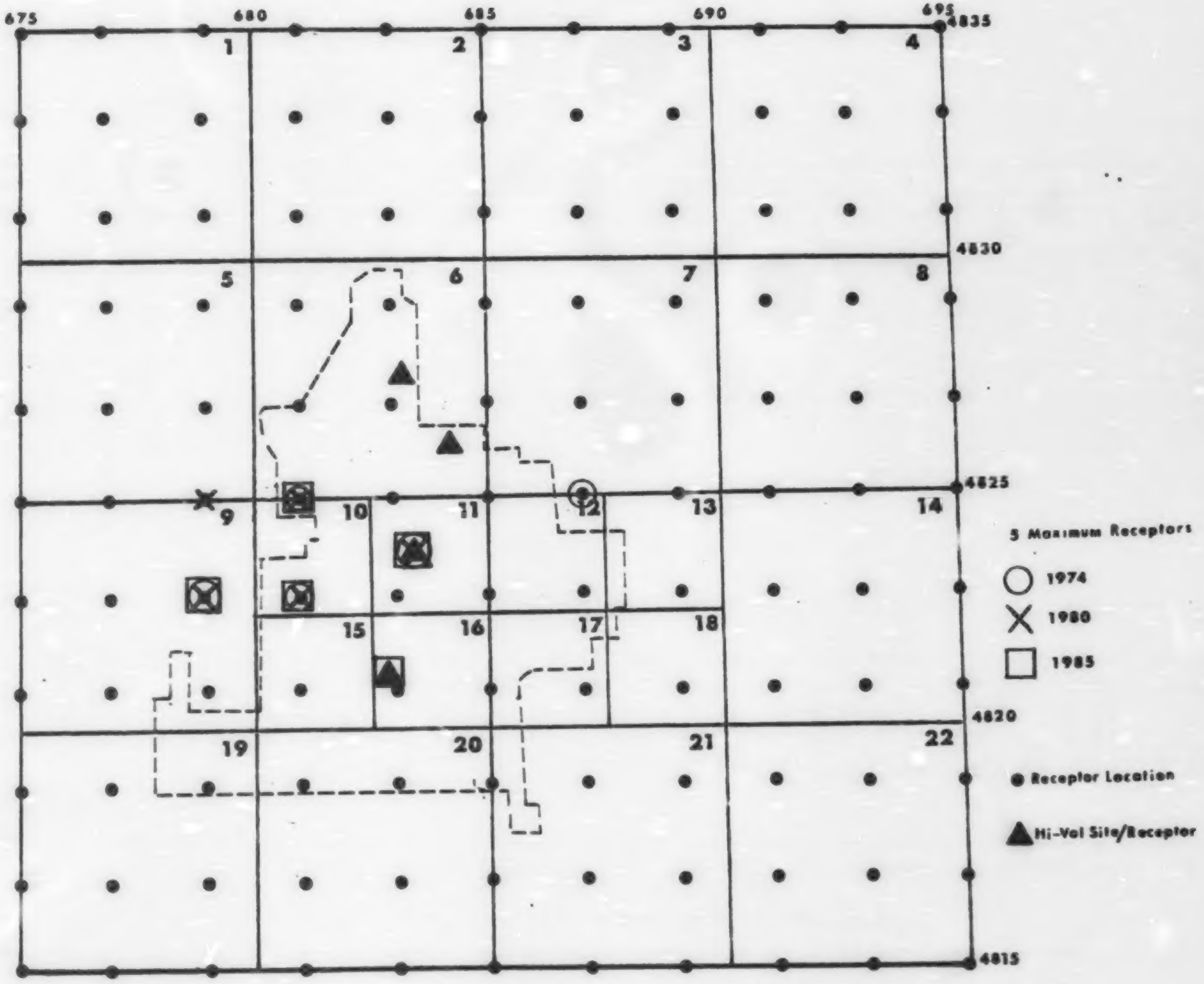
Again, the model was applied to the analysis area using the 1980 and 1985 emissions data, with other input data (meteorological parameters, receptors) remaining constant. Expected 1980 and 1985 annual geometric mean particulate concentrations were calculated. The procedures described in the preceding section were used to convert arithmetic concentrations to geometric concentrations and add background air quality.

Figures 4-8 and 4-9 show isopleths of the predicted concentrations in Sioux Falls for 1980 and 1985. The concentrations for both years are higher than the base year 1974 and exceed the secondary standard in 1985 only in one small section of the city. The maximum predicted concentration in 1985 is 61 ug/m^3.

Table 4-9. SOURCE CONTRIBUTION TABLE, 1974

Source						(Five maximum receptors) 39 ug/m^{3a}	%	72 ug/m^{3a}	%	27 ug/m^{3a}	%	124 ug/m^{3a}	%	38 ug/m^{3a}	%
Point Source No.															
Receptor	39	72	27	124	38										
	2	7	1	2	2	0.25	1.12	0.37	1.95	0.10	0.57	0.15	0.88	0.38	2.26
	11	12	2	5	11	0.32	1.45	0.19	1.01	4.45	24.57	0.09	0.55	0.19	1.12
	12	17	11	12	12	1.67	7.52	0.25	1.30	0.12	0.65	0.38	2.20	0.98	5.81
	13	18	12	18	17	0.39	1.77	3.69	19.45	0.61	3.34	0.09	0.50	0.14	0.82
	20	20	20	20	20	7.66	34.57	0.67	3.54	1.64	9.04	0.97	5.65	2.35	14.00
Subtotal						10.29	46.43	5.17	27.25	6.92	38.17	1.68	9.78	4.04	24.01
Area Source Grids															
Receptor	39	72	27	124	38										
	21	25	21	25	25	0.74	3.33	0.76	4.00	0.67	3.71	0.88	5.12	1.05	6.28
	25	26	25	26	29	1.09	4.94	0.82	4.33	1.08	5.99	0.72	4.19	0.85	5.07
	26	27	26	29	30	0.94	4.24	1.33	7.03	0.67	3.67	0.89	5.14	1.93	11.51
	29	31	29	31	31	0.90	4.07	0.94	4.98	1.96	10.84	3.85	22.37	0.73	4.36
	20	32	39	36	39	1.23	5.56	1.19	6.30	0.80	4.41	0.79	4.58	0.81	4.85
Subtotal						4.90	22.14	5.04	26.64	5.18	28.62	7.13	41.40	5.37	32.07
Total						15.19	68.57	10.21	53.89	12.10	66.79	8.81	51.18	9.41	56.08
All Point Sources						10.84	48 92	5.55	29.27	7.20	39.71	1.99	11.55	4.35	25.92
All Area Sources						11.32	51.08	13.41	70.73	10.93	60.29	15.24	88.45	12.43	74.08

[a] Arithmetic values (no background).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○ 1974
X 1980
□ 1985
● Receptor Location
▲ Hi-Vol Site/Receptor

Figure 4-6   Sioux Falls analysis area; five maximum receptor locations.

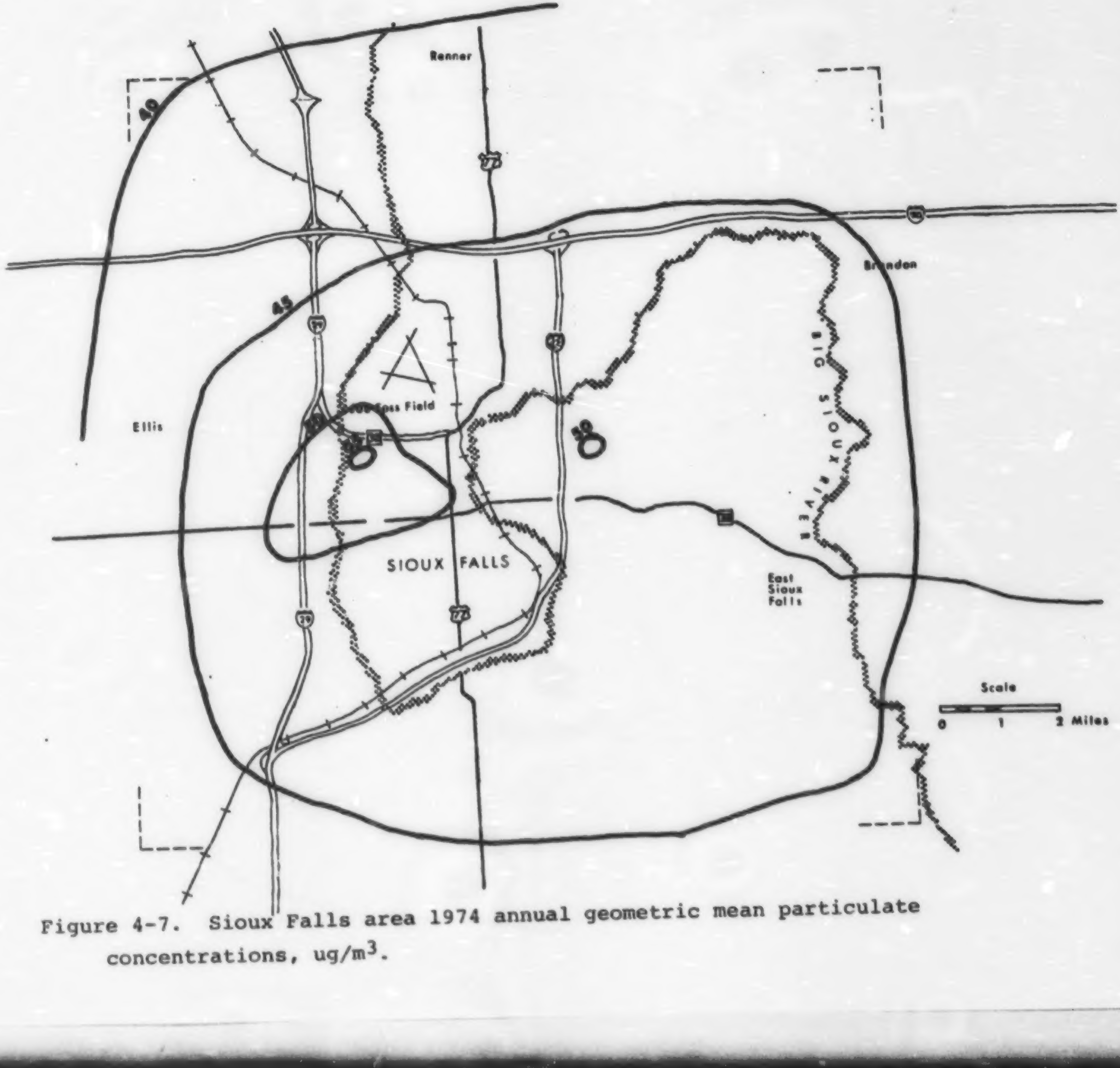
Renner
40
77
45
29
Foss Field
50
Brandon
BIG SIOUX RIVER
Ellis
SIOUX FALLS
East Sioux Falls
Scale
0
1
2 Miles

Figure 4-7. Sioux Falls area 1974 annual geometric mean particulate concentrations, ug/m³.

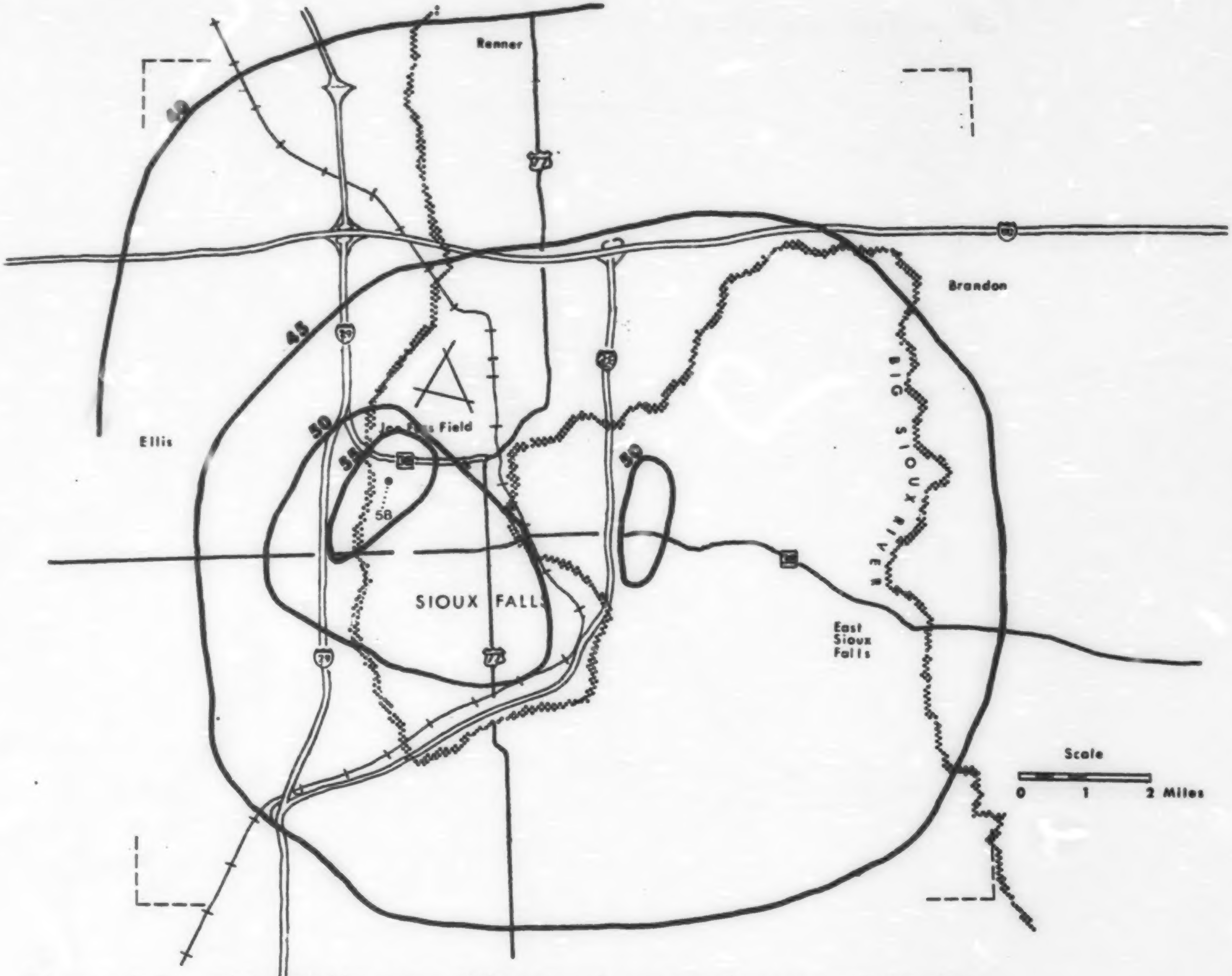
Renner
Brandon
Ellis
Field
45
50
55
58
50
SIOUX FALLS
BIG SIOUX RIVER
East Sioux Falls
Scale
0
1
2 Miles

Figure 4-8. Sioux Falls area 1980 annual geometric mean particulate concentrations, ug/m^3.

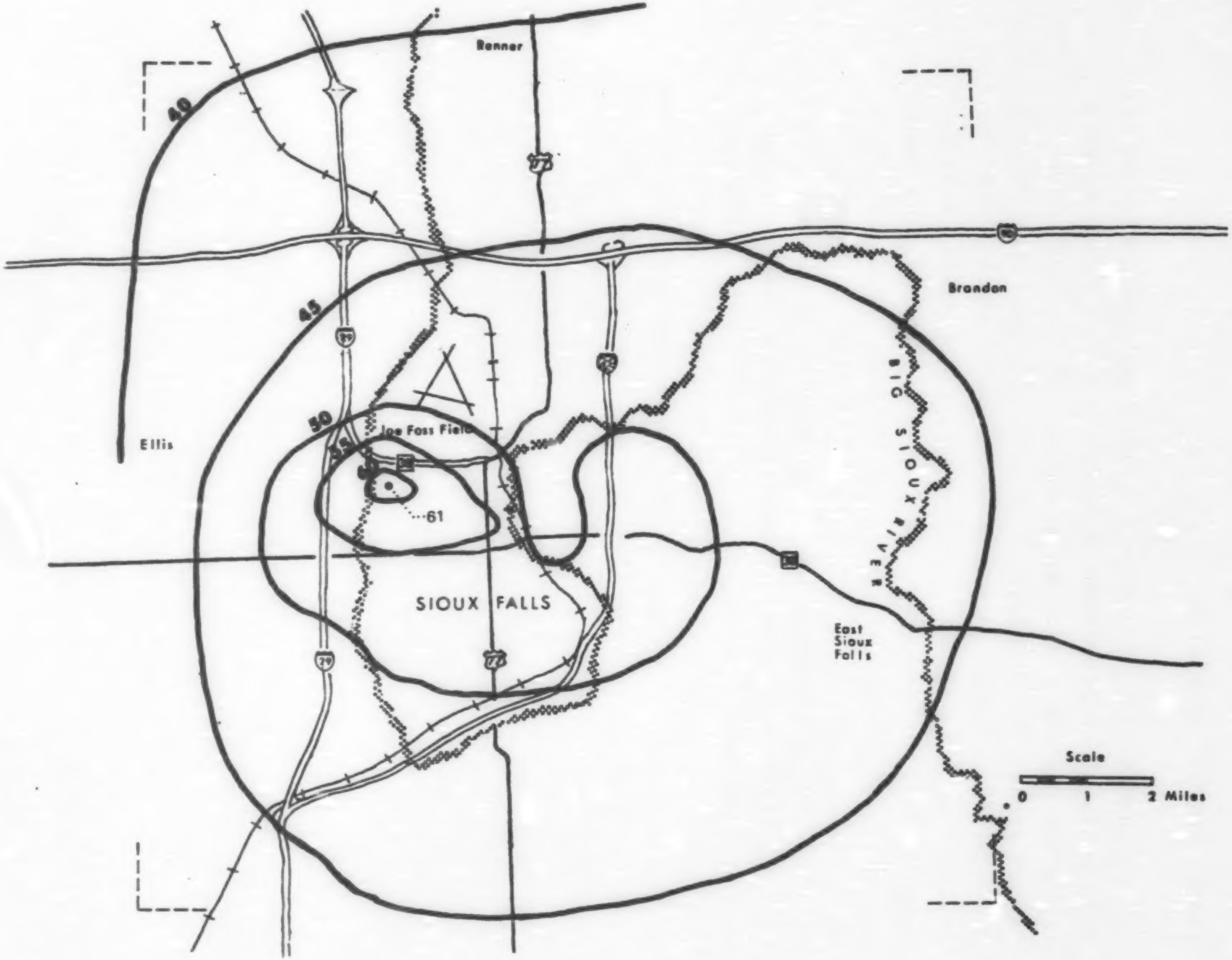
Renner
Ellis
Brandon
40
45
50
55
60
61
Joe Foss Field
SIOUX FALLS
BIG SIOUX RIVER
East
Sioux
Falls
29
77
Scale
0
1
2 Miles

Figure 4-9. Sioux Falls area 1985 annual geometric mean particulate concentrations, ug/m^3.

SHORT TERM TSP ANALYSIS

In addition to the annual NAAQS, compliance with short-term particulate standards (24-hour) must also be evaluated since the maximum predicted concentrations in 1985 just barely exceed the secondary standard. Various models exist for evaluating compliance with these standards.[16] Most, however, require specific assumptions as to which probable combinations of short-term emission rates and adverse meteorological conditions will yield peak ambient concentrations. As a result most of these models are difficult to apply.

One technique which has been found to be satisfactory in most cases and which is easy to apply is the empirical mathematical model developed by Larsen.[21] This technique expresses air pollution concentrations as a function of averaging time and frequency, and it assumes that the following characteristics hold true for any given data set under consideration:

- pollutant concentrations are log-normally distributed for all averaging times; and
- median concentrations are proportional to averaging time raised to an exponent.

Given these assumptions, Larsen's model may be expressed as:

$$C_{max} = M_g(S_g)^z \quad \text{(eq.2)}$$

where C_{max} = the maximum concentration expected for the time period of concern (in the case of TSP 24 hours)
M_g = annual geometric mean
S_g = standard geometric deviation
z = an empirical value representing

the number of standard deviations
from the geometric mean that
corresponds to the desired aver-
aging period (or, in other words,
to the desired percentile on a
normal probability curve)

This model is derived from the observation that, when plotted on log probability paper, most air quality data will form a nearly straight line. This observation suggests that when the logarithm of concentrations is plotted on one axis and the number of samples on the other, the resulting curve will follow the familiar bell-shaped curve. With this in mind, and having access to the geometric mean and standard geometric deviation of the data, it is a relatively straightforward process to calculate the concentration for any one percentile. Since a given percentile will correspond to a specific averaging time for a given set of data, it is also relatively easy to calculate an expected maximum concentraion. One simply needs to know the number of standard deviations (z) on a normal probability curve that corresponds to the desired maximum concentration for a selected averaging time. In the case of a 24-hour average, this number (z) is 2.94.[22] When used in equation 2, one can easily calculate the maximum 24-hour average for a given annual geometric mean and standard geometric deviation.

Larsen's technique was used in this analysis to determine whether or not the expected maximum short-term concentration for TSP exceeds the respective standards. No effort has been made to assess formal compliance with the standards since they are expressed in terms of levels "not to be exceeded more than once per year," or, in other words, the second maximum. It is assumed that the maximum and second maximum are essentially equivalent and that where the former exceeds the standards, the latter will probably do likewise.

The expected maximum 24-hour concentration was computed for the City Hall hi vol site for 1985. This site had the highest AQDM predicted annual geometric mean--54 ug/m^3. Using this value, the average standard geometric deviation (S_g) for the four sites (1.65), and a z value of 2.94, the expected maximum 24-hour concentration is 235 ug/m^3, well in excess of the secondary standard of 150 ug/m^3. Solving equation 2 for the annual geometric mean beyond which the 24-hour maximum would be exceeded produced a value of 34.4 ug/m^3. All the current hi vol sites are projected to measure annual means greater than this in 1980 and 1985.

APPENDIX A

POINT SOURCE DATA FOR MINNEHAHA AND PENNINGTON COUNTIES AND AQDM SOURCE INPUT DATA

Table A-1. POINT SOURCE DATA FOR MINNEHAHA AND PENNINGTON COUNTIES, 1974

	I.C. NUMBER ST CC AQ PLT	PT	YR	PLANT/POINT NAME	UTM COORD,KM HORIZ	 VERT	----STACK DATA----- HT. (FT)	 DIA (FT)	 TEMP (F)	 FLOW (ACFM)	 PLUME HT	ESTIMATED EMISSIONS, TPY PART	 SO2	 NOX	 HC	 CO	ALLOWABLE EMISS,TPY PART	 SO2
	0000			COUNTY CODES-SOUTH DAKOTA	.	.		.										
	1220			MINNEHAHA COUNTY	.	.		.										
	1300			PENNINGTON COUNTY	.	.		.										
	4312200870000	00			.	.		.										
	4312200870000	01		MINNEHAHA CO. PT. SOURCES	.	.		.										
	4312200870000	02			.	.		.										
16	4312200870001	01	74	NSP CO.-LAWRENCE/BOILER	690.7	4830.3	165	9.7	380	70000		56					148	
16	4312200870001	02	74	NSP CO.-LAWRENCE/BOILER	690.7	4830.3	165	9.7	380	70000		56					148	
16	4312200870001	03	74	NSP CO.-LAWRENCE/BOILER	690.7	4830.3	165	9.7	320	93000		276					240	
15	4312200870002	01	74	NSP CO.-PATHFINDER/BOILER	688.8	4828.8	150	8.0	360	91000		16						
15	4312200870002	02	74	NSP CO.-PATHFINDER/BOILER	688.8	4828.8	150	8.0	360	91000		16						
15	4312200870002	03	74	NSP CO.-PATHFINDER/BOILER	688.8	4828.8	150	8.0	360	91000		16						
	4312200870012	01	72	L.G.EVERIST /PRIM.CRUSHIN	685.1	4854.6		.	77E			2					44	
	4312200870012	02	72	L.G.EVERIST /SECY.CRUSHIN	685.1	4854.6		.	77E			6					20	
	4312200870012	03	72	L.G. EVERIST/SCREENING	685.1	4854.6		.	77E			8					44	
	4312200870021	01	74	GARRETSON FARMCOOP/SHPREC	700.9	4843.2		.	77E			117					61	
	4312200870021	02	74	GARRETSON FARMCOOP/GR.DRY	700.9	4843.2		.	77E			8					4	
	4312200870021	03	74	GARRETSON FARMCOOP/FEECGR	700.9	4843.2		.	77E			6					14	
	4312200870021	04	74	GARRETSON FARMCOOP/SCALP	700.9	4843.2		.	77E			3					2	
	4312200870021	05	74	GARRETSON FARMCOOP/FEEDR	700.9	4843.2		.	77E			27					10	
	4312200870021	06	74	GARRETSON FARMCOOP/FEEDMX	700.9	4843.2		.	77E			78					26	
	4312200870021	07	74	GARRETSON FARMCOOP/BLNDFE	700.9	4843.2		.	77E			1					2	
	4312200870021	08	74	GARRETSON FARMCOOP/BAGFER	700.9	4843.2		.	77E			0					1	
11	4312200870037	01	74	CONCRETE MATLS CO/ASPH BT	680.2	4825.1	20E	10.0E	300E			35					43	
17	4312200870088	01	74	UNKNOWN	684.0	4824.0	212	9.0	77E			1					4	
17	4312200870088	02	74	UNKNOWN	684.0	4824.0		.	77E			1					4	
17	4312200870088	03	74	UNKNOWN	684.0	4824.0	112	7.0	77E			42					162	
17	4312200870088	04	74	UNKNOWN	684.0	4824.0	117	3.0	77E			50					193	

Table A-1 (continued). POINT SOURCE DATA FOR MINNEHAHA AND PENNINGTON COUNTIES, 1974

	I.D. NUMBER				UTM COORD,KM		STACK DATA					ESTIMATED EMISSIONS, TPY					ALLOWABLE EMISS,TPY	
	ST CC AQ PLT	PT	YR	PLANT/POINT NAME	HORIZ	VERT	HT. (FT)	DIA (FT)	TEMP (F)	FLOW (ACFM)	PLUME HT	PART	SO2	NOX	HC	CO	PART	SO2
17	4312200870008	05	74	UNKNOWN	684.0	4824.0	57	.8	77E			0					1	
12	4312200870108	01	74	CONCRETE MATLS CO/ASPH BT	680.2	4825.1	20E	10.0E	300E			141					25	
12	4312200870108	02	74	CONCRETE MATLS CO/ASPH BT	680.2	4825.1	20E	10.0E	300E			40					25	
9	4312200870109	01	74	SWEETMAN CONST CO/CONC BT	680.1	4825.0	20E	10.0E	77E			3					72	
9	4312200870109	02	74	SWEETMAN CONST CO/CONC BT	680.1	4825.0	20E	10.0E	77E			0						
20	4312200870110	01	74	CONCRETE MATL CO/PRI CRSH	680.2	4825.1	20E	10.0E	77E			17					63	
20	4312200870110	02	74	CONCRETE MATL CO/SEC CRSH	680.2	4825.1	20E	10.0E	77E			50					63	
20	4312200870110	03	74	CONCRETE MATL CO/TER CRSH	680.2	4825.1	20E	10.0E	77E			202					63	
18	4312200870111	01	74	CONCRETE MATLS CO/SAND PL	686.9	4825.5	5E	5.0E	77E			9					45	
18	4312200870112	01	74	CONCRETE MATL CO/SAND PL	686.9	4825.5	5E	5.0E	77E			20					53	
14	4312200870113	01	74	SWEETMAN CONST CO/CONC BT	680.1	4825.0	20E	10.0E	77E			2					52	
14	4312200870113	02	74	SWEETMAN CONST CO/CONC BT	680.1	4825.0	20E	10.0E	77E			0						
	4312200879901	01	72	HARTFORD COOP FARM/SHPREC	.	.		.	77E			10						
	4312200879901	02	72	HARTFORD COOP FARM/GR CLN	.	.		.	77E			38						
	4312200879901	03	72	HARTFORD COOP FARM/GR DRY	.	.		.	77E			120						
	4312200879901	04	72	HARTFORD COOP FARM/GRNDMX	.	.		.	77E			0						
	4312200879902	01	72	BALTIC FARMER FL/SHIP REC	681.9	4847.6	20	.	77E			7						
	4312200879902	02	72	BALTIC FARMER FL/HANDLING	681.9	4847.6	20	.	77E			7						
	4312200879902	03	72	BALTIC FARMER FL/GRIND MX	681.9	4847.6	6	.	77E			6						
	4312200879902	04	72	BALTIC FARMER EL/CLEANING	681.9	4847.6	4	.	77E			1						
	4312200879902	05	72	BALTIC FARMER FL/MIX FERT	681.9	4847.6	0	.	77E			12						
	4312200879903	01	72	CORSON COOP CO/SHIP & REC	695.9	4831.9	100	.	77E			5						
	4312200879903	02	72	CORSON COOP CO/HANDLING	695.9	4831.9	100	.	77E			5						
	4312200879903	03	72	CORSON COOP CO/GRIND MIX	695.9	4831.9	60	.	77E			6						
	4312200879903	04	72	CORSON COOP CO/GRAIN DRY	695.9	4831.9	30	.				1						
	4312200879903	05	72	CORSON COOP CO/BLEND FERT	695.9	4831.9	0	.	77E			5						
	4312200879904	01	72	DELL RAPIDS GRAIN/SHIP&RE	683.9	4854.4	0	.	77E			6						
	4312200879904	02	72	DELL RAPIDS GRAIN/HANDLIN	683.9	4854.4		.	77E			6						

Table A-1 (continued). POINT SOURCE DATA FOR MINNEHAHA AND PENNINGTON COUNTIES, 1974

	I.D. NUMBER				UTM COORD,KM		STACK DATA					ESTIMATED EMISSIONS, TPY					ALLOWABLE EMISS,TPY	
	ST CC AC PLT	PT	YR	PLANT/POINT NAME	HORIZ	VERT	HT. (FT)	DIA (FT)	TEMP (F)	FLOW (ACFM)	PLUME HT	PART	SO2	NOX	HC	CO	PART	SO2
	4312200879904	03	72	DELL RAPIDS GRAIN/GRINDFE	683.9	4854.4		.				13						
	4312200879904	04	72	DELL RAPIDS GRAIN/MIX FER	683.9	4854.4		.	77E			9						
	4312200879904	05	72	DELL RAPIDS GRAIN/GRN DRY	683.9	4854.4		.				3						
	4312200879905	01	72	CROOKS FARM COOP/SHIP REC	.	.		.	77E			6						
	4312200879905	02	72	CROOKS FARM COOP/HANDLING	.	.		.	77E			6						
	4312200879905	03	72	CROOKS FARM COOP/GRN FEED	.	.		.	77E			5						
	4312200879905	04	72	CROOKS FARM COOP/MIX FERT	.	.		.	77E			5						
	4312200879906	01		HUMBOLDT FARM EL/SHP RECV	.	.		.	77E			5						
	4312200879906	02		HUMBOLDT FARM EL/HANDLING	.	.		.	77E			5						
	4312200879906	03		HUMBOLDT FARM EL/GR CLEAN	.	.		.	77E			8						
	4312200879906	04		HUMBOLDT FARM EL/MILL&MIX	.	.		.	77E			4						
	4312200879906	05		HUMBOLDT FARM EL/BLNDFERT	.	.		.	77E			15						
	4312200879907	01	72	COLTON FARM EL/SHIP & REC	.	.		.	77E			10						
	4312200879907	02	72	COLTON FARM EL/HANDLING	.	.		.	77E			10						
	4312200879907	03	72	COLTON FARM EL/CLEANING	.	.		.	77E			1						
	4312200879907	04	72	COLTON FARM EL/GRAIN DRY	.	.		.				2						
	4312200879907	05	72	COLTON FARM EL/GRIND & MX	.	.		.	77E			47						
	4312200879908	01	72	VALLEY SPRINGS FARM EL/SH	.	.		.	77E			1						
	4312200879908	02	72	VALLEY SPRINGS FARM EL/HD	.	.		.	77E			1						
	4312200879908	03	72	VALLEY SPRINGS FARM EL/FD	.	.		.	77E			1						
1	4312200879909	01	72	FARM UNION CENT.EX/SHPREC	675.2	4825.4	10E	5.0E	77E			3						
1	4312200879909	02	72	FARM UNION CENT.EX/HANDLG	675.2	4825.4	10E	5.0E	77E			3						
1	4312200879909	03	72	FARM UNION CENT.EX/BLDFER	675.2	4825.4	10E	5.0E	77E			30						
2	4312200879910	01	72	GOLDEN SUN FEEDS/RECEHAND	678.6	4823.3	10E	5.0E	77E			20						
2	4312200879910	02	72	GOLDEN SUN FEEDS/BLD FEED	678.6	4823.3	15E	5.0E	77E			20						
2	4312200879910	03	72	GOLDEN SUN FEEDS/PELLETIN	678.6	4823.3	20E	5.0E	77E			0						
2	4312200879910	04	72	GOLDEN SUN FEEDS/BLOCKING	678.6	4823.3	20E	5.0E	77E			0						
2	4312200879910	05	72	GOLDEN SUN FEEDS/BAG FEED	678.6	4823.3	15E	5.0E	77E			0						

Table A-1 (continued). POINT SOURCE DATA FOR MINNEHAHA AND PENNINGTON COUNTIES, 1974

	I.D. NUMBER ST CC AQ PLT	PT	YR	PLANT/POINT NAME	UTM COORD,KM HORIZ	UTM COORD,KM VERT	STACK DATA HT. (FT)	STACK DATA DIA (FT)	STACK DATA TEMP (F)	STACK DATA FLOW (ACFM)	STACK DATA PLUME HT	ESTIMATED EMISSIONS, TPY PART	ESTIMATED EMISSIONS, TPY SO2	ESTIMATED EMISSIONS, TPY NOX	ESTIMATED EMISSIONS, TPY HC	ESTIMATED EMISSIONS, TPY CO	ALLOWABLE EMISS,TPY PART	ALLOWABLE EMISS,TPY SO2
	4312200879911	01	72	JONES MILL & EL/SHIP	.	.		.	77E			3						
	4312200879911	02	72	JONES MILL & EL/HANDLING	.	.		.	77E			3						
	4312200879911	03	72	JONES MILL & EL/GRAIN DRY	.	.		.	77E			0						
	4312200879911	04	72	JONES MILL & EL/GRIND&MIX	.	.		.	77E			0						
3	4312200879912	01	72	PURE PLANT FD.INT/HDL.FER	686.6	4825.7	30E	5.0E	77E			1						
4	4312200879913	01	72	ZIP FEED MILLS/SHIP & REC	684.1	4824.0	15E	10.0E	77E			0						
4	4312200879913	02	72	ZIP FEED MILLS/HANDLING	684.1	4824.0	15E	10.0E	77E			0						
4	4312200879913	03	72	ZIP FEED MILLS/GRINDING	684.1	4824.0	220	10.0E	77E			0						
4	4312200879913	04	72	ZIP FEED MILLS/MIXING	684.1	4824.0	200	10.0E	77E			1						
4	4312200879913	05	72	ZIP FEED MILLS/PELLETING	684.1	4824.0	200	10.0E	77E			0						
5	4312200879914	01	72	CITY OF SIOUX FALLS/AS.BT	684.3	4826.4	50E	10.0E	300E			30						
	4312200879915	01	73	MYRL&ROY'S PAVING/ASP BAT	673.2	4825.5		.				7						
	4312200879915	02	73	MYRL&ROY'S PAVING/ASP BAT	673.2	4825.5		.				15						
6	4312200879916	01	72	CONC.MATL.CO/CONCRETE BAT	680.2	4825.1	20E	10.0E	77E			1						
7	4312200879917	01	72	EAGLE MATL CO/SAND PROCES	686.8	4825.5	20E	5.0E	77E			4						
8	4312200879918	01	72	SAGE BROS.CONC PRCD/CON B	678.5	4825.3	20E	10.0E	77E			0						
10	4312200879919	01	72	TRAUB SILO CC/CNCRET BAT	684.6	4826.8	5E	10.0E	77E			0						
13	4312200879920	01	72	SWEETMAN CONST CO/ROCK DR	680.1	4825.0	5E	1.0E	77E			7					72	
	4312200879921	01	72	SHERMAN FARM CCOP/SHP&REC	.	.		.	77E			6						
	4312200879921	02	72	SHERMAN FARM CCOP/HANDLIN	.	.		.	77E			6						
	4312200879921	03	72	SHERMAN FARM CCOP/DRYING	.	.		.				3						
19	4312200879922	01	74	EAGLE MATLS CC/CONC BTCH	686.4	4825.6	20E	10.0E	77E			0						
	4312200879923	01		TRAIL A MIX CONCRETE	.	.		.										
	4312200879924	01		JORDAN MILLWORK CC/NCDATA	.	.		.										
	4312200879925	01		WYLAND CONST CC/NC DATA	.	.		.										

Table A-1 (continued). POINT SOURCE DATA FOR MINNEHAHA AND PENNINGTON COUNTIES, 1974

	I.D. NUMBER				UTM COORD,KM		STACK DATA					ESTIMATED EMISSIONS, TPY					ALLOWABLE EMISS,TPY	
	ST CO AQ PLT	PT	YR	PLANT/POINT NAME	HORIZ	VERT	HT. (FT)	DIA (FT)	TEMP (F)	FLOW (ACFM)	PLUME HT	PART	SO2	NOX	HC	CO	PART	SO2
	4313002050000	00			.	.		.										
	4313002050000	01		PENNINGTON CO PT. SOURCES	.	.		.										
	4313002050000	02			.	.		.										
1	4313002050001	01	74	BLACK HILLS POWER & LIGHT	639.0	4882.8	200	11.0	295	124000		449					320	
2	4313002050005	01	74	SNOW BRITE LIME CO/PRICRU	637.5	4885.8		.	77E			10					40	
2	4313002050005	02	74	SNOW BRITE LIME CO/SECCRU	637.5	4865.8		.	77E			28					40	
2	4313002050005	03	74	SNOW BRITE LIME CO/SCREEN	637.5	4885.8		.	77E			38					40	
3	4313002050008	01	74	LIGHT AGREGATES INC./KILN	642.0	4883.0	75	3.3	800			295					40	
3	4313002050008	02	74	LIGHT AGGREGATES INC/CRSH	642.0	4883.0		.	77E			11					9	
4	4313002050009	01	75	HILLS MATLS.CO./ASPH.BTCH	638.9	4882.4		.				3						
4	4313002050009	02	75	HILLS MATLS.CO./ASPH.BTCH	638.9	4882.4		.				3						
4	4313002050009	03	75	HILLS MATLS.CO./CNCRT.MIX	638.9	4882.4		.				2						
5	4313002050010	01	74	HILLS MATL CO/ASPHALT BAT	642.0	4883.0		.				11					35	
6	4313002050011	01	74	S.D.CEMENT PLANT/	.	.		.										
6	4313002050011	02	74	S.D.CEMENT PLANT/PRI CRSH	638.3	4883.0		.	77F			58					218	
6	4313002050011	03	74	S.D.CEMENT PLANT/SEC CRSH	638.3	4883.0		.	77E			4					218	
6	4313002050011	04	74	S.D.CEMENT PLANT/PRI SCRN	638.3	4883.0		.	77E			3					218	
6	4313002050011	05	74	S.D.CEMENT PLANT/TER CRSH	638.3	4883.0		.	77E			0					218	
6	4313002050011	06	74	S.D.CEMENT PLANT/FIN MILL	638.3	4883.0		.	77E			3					201	
6	4313002050011	07	74	S.D.CEMENT PLANT/ROT KILN	638.3	4883.0		.				51					169	
6	4313002050011	08	74	S.D.CEMENT PLANT/ROT KILN	638.3	4883.0		.				51					169	
6	4313002050011	09	74	S.D.CEMENT PLANT/ROT KILN	638.3	4883.0		.				51					169	
7	4313002050013	01	74	PETE LIEN&SONS QUARRY/PCR	638.0	4884.0		.	77E			78					75	
7	4313002050013	02	74	PETE LIEN&SONS QUARRY/PSC	638.0	4884.0		.	77E			39					75	
7	4313002050013	03	74	PETE LIEN&SONS QUARRY/SCR	638.0	4884.0		.	77E			4					70	
7	4313002050013	04	74	PETE LIEN&SONS QUARRY/SSC	638.0	4884.0		.	77E			2					75	
7	4313002050013	05	74	PETE LIEN&SONS QUARRY/TSC	638.0	4884.0		.	77E			6					68	
8	4313002050014	01	74	PETE LIEN&SONS LIME/RKILN	638.0	4884.0	50	4.0	500	22000		2000					46	
8	4313002050014	02	74	PETE LIEN&SONS LIME/VKILN	638.0	4884.0	55	3.0	600	15700		1					14	
8	4313002050014	03	74	PETE LIEN&SONS LIME/HYDRA	638.0	4884.0		.				160						
9	4313002050015	01	75	SUMMIT INC./ASPHALT BATCH	638.3	4885.3		.				877					38	

Table A-1 (continued). POINT SOURCE DATA FOR MINNEHAHA AND PENNINGTON COUNTIES, 1974

	I.D. NUMBER				UTM COORD.KM		STACK DATA					ESTIMATED EMISSIONS, TPY					ALLOWABLE EMISS,TPY	
	ST CO AQ PLT	PT	YR	PLANT/POINT NAME	HORIZ	VERT	HT. (FT)	DIA (FT)	TEMP (F)	FLOW (ACFM)	PLUME HT	PART	SO2	NOX	HC	CO	PART	SO2
9	4313002050015	02	75	SUMMIT INC./PRIMARY CRUSH	638.3	4885.3		.	77E			88					57	
9	4313002050015	03	75	SUMMIT INC./SEC CRSH&SCRN	638.3	4885.3		.	77E			40					51	
9	4313002050015	04	75	SUMMIT INC./TER CRSH&SCRN	638.3	4885.3		.	77E			158					51	
9	4313002050015	05	75	SUMMIT INC./SCRN CNVY HND	638.3	4885.3		.	77E			53					51	
	4313002050034	01	74	BIRDSALL SAND GRAVEL/CONC	619.0	4918.0		.	77E			0					48	
	4313002050034	02	74	BIRDSALL SAND GRAVEL/STCR	619.0	4918.0		.	77E			3					48	
10	4313002050045	02	72	HIGHWAY CONST.CO/CRSH/SCR	637.6	4886.1		.				900						
11	4313002050046	01	75	HILLS MATL CO/PRIM CRUSH	637.2	4883.2		.	77E			64					37	
11	4313002050046	02	75	HILLS MATL CO/SECY CRUSH	637.2	4883.2		.	77E			19					37	
11	4313002050046	03	75	HILLS MATL CO/TERY CRUSH	637.2	4883.2		.	77E			23					37	
11	4313002050046	04	75	HILLS MATL CO/SCRN CONV H	637.2	4883.2		.	77E			26					37	
11	4313002050046	05	75	HILLS MATL CO/DRY MIX	637.2	4883.2		.	77E			0					2	
	4313002050050	01	74	S.DAK.DEPT.OF HIWY/ASPH.B	645.0	4878.0		.				98					30	
	4313002050050	02	74	S.DAK.DEPT.OF HIWY/ MISC.	645.0	4878.0		.				28					30	
	4313002050055	01	74	BIRDSALL SAND GRAVEL/CRSH	.	.		.	77E			8					38	
	4313002050105	01	74	BUCKINGHAM WOOD PRD/TPBUR	.	.	30	10.0				1					0	
	4313002050106	01	74	S.DAK.CNCRT.PROD/CNCR.BAT	644.9	4878.6		.	77E			7					16	
12	4313002059901	01	72	JAMES E.SIMON CO/ASPH.BAT	638.3	4884.8		.				10						
13	4313002059902	01	72	BIRDSALL SAND&GRAVEL/QUAR	641.9	4883.0		.				3						
13	4313002059902	02	72	BIRDSALL SAND&GRAVEL/CNCR	641.9	4883.0		.				5						
13	4313002059902	03	72	BIRDSALL SAND&GRAVEL/BOIL	641.9	4883.0		.				0						
14	4313002059903	01	72	DAKOTA BLOCK CO./CNCR.BLK	638.3	4884.0		.				2						
	4313002059904	01	73	HILLS RED E MIX/CNCR.BTCH	643.5	4881.9		.				0						
15	4313002059905	01	72	L.G.EVERIST.INC/CNCR.BTCH	637.0	4886.3		.				0						
	4313002059906	01	72	UNIT STEP NEW UNDRWD/CNCR	.	.		.				0						
	4313002059907	01		DAKOTA QUARTZ PROD/NODATA	.	.		.										
	4313002059908	01		DELZER CONST.CO./NO DATA	.	.		.										
	4313002059909	01		ANGEL AUTO SALVAGE/NODATA	.	.		.										

Table A-1 (continued). POINT SOURCE DATA FOR MINNEHAHA AND PENNINGTON COUNTIES, 1974

	I.D. NUMBER				UTM COORD.KM		STACK DATA					ESTIMATED EMISSIONS, TPY					ALLOWABLE EMISS.TPY	
	ST CC AQ PLT	PT	YR	PLANT/POINT NAME	HORIZ	VERT	HT. (FT)	DIA (FT)	TEMP (F)	FLOW (ACFM)	PLUME HT	PART	SO2	NOX	HC	CO	PART	SO2
	4313002059910	01		B&B AUTO SALVAGE/NO DATA	.	.		.										
16	4313002059911	01	72	ABY'S FEED&SEED/HAMMERMIL	642.1	4882.1		.	77E			2						
16	4313002059911	02	72	ABY'S FEED&SEED/DISK SEED	642.1	4882.1		.	77E			0						
16	4313002059911	03	72	ABY'S FEED&SEED/GRAV CLN	642.1	4882.1		.	77E			0						
16	4313002059911	04	72	ABY'S FEED&SEED/SCRN CLN	642.1	4882.1		.	77E			0						
	4313002059912	01	72	HUBBARD MILL-UNDRWD/SH	.	.		.	77E		20E	4						
	4313002059912	02	72	HUBBARD MILL-UNDRWD/HANDL	.	.		.	77E		20E	4						
	4313002059912	03	72	HUBBARD MILL-UNDRWD/ROLLE	.	.		.	77E			4						
	4313002059912	04	72	HUBBARD MILL-UNDRWD/CLEAN	.	.		.	77E			0						
	4313002059913	01	72	HUBBARD MILL-WALL/SHP.REC	.	.		.	77E		20E	7						
	4313002059913	02	72	HUBBARD MILL-WALL/HANDLNG	.	.		.	77E		20E	7						
	4313002059913	03	72	HUBBARD MILL-WALL/ROLLING	.	.		.	77E		20E	7						
	4313002059914	01	72	ANDERSON MILLWORK/SAWING	.	.		.	77E		20E	0						
	4313002059914	02	72	ANDERSON MILLWORK/SANDING	.	.		.	77E		20E	0						
	4313002059914	03	72	ANDERSON MILLWORK/PLANING	.	.		.	77E		20E	0						
	4313002059915	01	72	RUSHMORE HOMES INC./INCIN	.	.		.				0						
17	4313002059916	01	72	HUBBARD MILLING CO/FEED	642.2	4882.5		.	77E			15						
17	4313002059916	02	72	HUBBARD MILLING CO/FLOUR	642.2	4882.5		.	77E			18						

Table A-2. SIOUX FALLS AREA AIR QUALITY ANALYSIS: SIOUX FALLS, S.D. 1974

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SOURCE DATA

SOURCE NUMBER	SOURCE NAME	SOURCE LOCATION (KILOMETERS)		SOURCE AREA SQUARE KILOMETERS	ANNUAL SOURCE EMISSION RATE (TONS/DAY)		STACK DATA			
		HORIZONTAL	VERTICAL		SO2	PART	HT (M)	DIAM (M)	VEL (M/SEC)	TEMP (DEG.K)
1	Farm Union Central Exchange	675.2	4825.4	0.0	0.0	0.099	3.0	1.5	0.3	298.
2	Golden Sun Feeds	678.6	4823.3	0.0	0.0	0.110	4.6	1.5	0.3	298.
3	Pure Plant Food International	680.5	4823.7	0.0	0.0	0.003	9.1	1.5	0.3	298.
4	Zip Feed Mills	684.1	4824.0	0.0	0.0	0.003	61.0	3.0	0.3	298.
5	City of Sioux Falls	684.3	4826.4	0.0	0.0	0.082	15.2	3.0	1.5	422.
6	Concrete Materials Company	680.2	4825.1	0.0	0.0	[illegible]	6.1	3.0	1.5	298.
7	Eagle Materials Company	680.8	4825.5	0.0	0.0	0.011	6.1	1.5	1.5	298.
8	Gage Bros. Concrete Products	676.5	4823.3	0.0	0.0	0.0	6.1	3.0	1.5	298.
9	Sweetman Construction Company	680.1	4825.0	0.0	0.0	0.008	6.1	3.0	1.5	298.
10	Traub Silo Company	684.6	4826.8	0.0	0.0	0.0	1.5	3.0	1.5	298.
11	Concrete Materials Company	680.2	4825.1	0.0	0.0	0.096	6.1	3.0	1.5	422.
12	Concrete Materials Company	680.2	4825.1	0.0	0.0	0.590	6.1	3.0	1.5	422.
13	Sweetman Construction Company	680.1	4825.0	0.0	0.0	0.019	1.5	0.3	0.3	298.
14	Sweetman Construction Company	680.1	4825.0	0.0	0.0	0.005	6.1	3.0	1.5	298.
15	Northern States Power Company	[illegible]	[illegible]	0.0	0.0	0.132	[illegible]	2.9	[illegible]	[illegible]
16	Pathfinder Plant	659.7	4833.3	0.0	0.0	1.063	50.3	3.0	16.0	467.
17	NSPC--Lawrence Plant	684.0	4824.0	0.0	0.0	0.258	64.6	2.7	1.5	298.
18	Unknown	[illegible]	4825.2	0.0	0.0	0.070	1.5	1.5	1.5	298.
19	Concrete Materials Company	680.4	4825.0	0.0	0.0	0.0	6.1	3.0	1.5	298.
20	Eagle Materials Company	680.2	4825.1	0.0	0.0	0.737	6.1	3.0	1.5	298.
	Concrete Materials Company									
21	AREA SOURCE GRID 1	677.5	4832.5	25.00	0.0	1.575	9.1	0.0	0.0	0.
22	AREA SOURCE GRID 2	682.5	4832.5	25.00	0.0	1.378	9.1	0.0	0.0	0.
23	AREA SOURCE GRID 3	687.5	4832.5	25.00	0.0	1.477	9.1	0.0	0.0	0.
24	AREA SOURCE GRID 4	692.5	4832.5	25.00	0.0	1.573	9.1	0.0	0.0	0.
25	AREA SOURCE GRID 5	677.5	4827.5	25.00	0.0	1.752	9.1	0.0	0.0	0.
26	AREA SOURCE GRID 6	682.5	4827.5	25.00	0.0	1.282	9.1	0.0	0.0	0.
27	AREA SOURCE GRID 7	687.5	4827.5	25.00	0.0	1.508	9.1	0.0	0.0	0.
28	AREA SOURCE GRID 8	692.5	4827.5	25.00	0.0	1.263	9.1	0.0	0.0	0.
29	AREA SOURCE GRID 9	677.5	4822.5	25.00	0.0	1.466	9.1	0.0	0.0	0.
30	AREA SOURCE GRID 10	681.3	4823.8	6.30	0.0	0.436	9.1	0.0	0.0	0.
31	AREA SOURCE GRID 11	683.8	4823.8	6.30	0.0	0.734	9.1	0.0	0.0	0.
32	AREA SOURCE GRID 12	686.3	4823.8	6.30	0.0	0.573	9.1	0.0	0.0	0.
33	AREA SOURCE GRID 13	688.8	4823.8	6.30	0.0	0.507	9.1	0.0	0.0	0.
34	AREA SOURCE GRID 14	692.5	4822.5	25.00	0.0	1.625	9.1	0.0	0.0	0.
35	AREA SOURCE GRID 15	681.3	4821.3	6.30	0.0	0.466	9.1	0.0	0.0	0.
36	AREA SOURCE GRID 16	683.8	4821.3	6.30	0.0	0.712	9.1	0.0	0.0	0.
37	AREA SOURCE GRID 17	686.3	4821.3	6.30	0.0	0.304	9.1	0.0	0.0	0.
38	AREA SOURCE GRID 18	688.8	4821.3	6.30	0.0	0.300	9.1	0.0	0.0	0.
39	AREA SOURCE GRID 19	677.5	4817.5	25.00	0.0	1.720	9.1	0.0	0.0	0.
40	AREA SOURCE GRID 20	682.5	4817.5	25.00	0.0	1.504	9.1	0.0	0.0	0.
41	AREA SOURCE GRID 21	687.5	4817.5	25.00	0.0	1.767	9.1	0.0	0.0	0.
42	AREA SOURCE GRID 22	692.5	4817.5	25.00	0.0	1.553	9.1	0.0	0.0	0.

APPENDIX B

RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATES

Table B-1. RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATE

Grid No. 1
Description: Northwest of city, quarry areas
Area of grid, sq mi: 1.52

Source category	Emission factor	Emission level parameters	Particulate emissions, ton/yr 1974	GF[a]	1980	GF	1985
Fugitive dust							
Unpaved roads	4.0 lb/VMT	2.8 mi; ADT=21; 365 da/yr	43	1.0	43	1.0	43
Paved roads	0.04 lb/VMT	4.0 mi; 0.7x10^6 VMT/yr	14	1.34	19	1.5	21
Unpaved shoulders	0.3 ton/ac/yr	0.4 mi; or (1.0 ac)	neg	1.34	neg	1.5	neg
Road sanding	0.003 lb/VMT	4.0 mi; 0.7x10^6 VMT/yr	1	1.34	1	1.5	2
Unpaved parking lots	0.29 ton/ac/yr	3.0 ac	1	1.0	1	1.0	1
Gravel pits	9.4 ton/ac/yr	150 ac	1410	1.14	1607	1.24	1748
RR rights-of-way	0.3 ton/ac/yr	1.6 mi; or (7.8 ac)	2	1.0	2	1.0	2
Aggregate storage	9.4 ton/ac/yr	12 ac	113	1.0	113	1.0	113
Conventional							
Point source	--	--	976		129		149
Stationary source fuel combustion	--	grid/county popl = .05[b]	2	1.03	2	1.14	2
Mobile sources	--	grid/county VMT = .004[b]	1	1.07	1	1.03	1
Combustion of solid wastes	--	incinerators/grid	neg	1.0	neg	1.0	neg
Total			2563	0.74	1918	0.79	2082
Emission density, ton/sq mi/yr			1686		1262		1370

[a] GF = growth factor (see Area Source Inventory)

[b] multiply by county emissions (see Area Source Inventory)

Table B-2. RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATE

Grid No. 2
Description: Northwest of city, I-90 east-west corridor
Area of grid, sq mi: 2.88

Source category	Emission factor	Emission level parameters	Particulate emissions, ton/yr 1974	GF[a]	1980	GF	1985
Fugitive dust							
Unpaved roads	4.0 lb/VMT	0.9 mi; ADT=21; 365 da/yr	14	1.0	14	1.0	14
Paved roads	0.04 lb/VMT	19.5 mi; 3.5x10^6 VMT/yr	70	1.34	94	1.5	105
Active construction	6.4 ton/ac/yr	16 ac	102	1.14	116	1.24	126
Road sanding	0.003 lb/VMT	19.5 mi; 3.5x10^6 VMT/yr	5	1.34	7	1.5	8
Unpaved parking lots	0.29 ton/ac/yr	3.0 ac	1	1.0	1	1.0	1
Gravel pits	9.4 ton/ac/yr	5.0 ac	47	1.14	54	1.24	58
Aggregate storage	9.4 ton/ac/yr	10 ac	94	1.0	94	1.0	94
Conventional							
Point source	--	--	1216		300		346
Stationary source fuel combustion	--	grid/county popl = .03[b]	1	1.03	1	1.14	1
Mobile sources	--	grid/county VMT = .011[b]	3	1.07	3	1.03	3
Combustion of solid wastes	--	incinerators/grid	neg	1.0	neg	1.0	neg
Total			1553	0.40	684	0.42	756
Emission density, ton/sq mi/yr			539		238		263

[a] GF = growth factor (see Area Source Inventory)

[b] multiply by county emissions (see Area Source Inventory)

Table B-3. RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATE

Grid No. 3
Description: West of city, westernmost grid
Area of grid, sq mi: 1.51

Source category	Emission factor	Emission level parameters	Particulate emissions, ton/yr 1974	GF[a]	1980	GF	1985
Fugitive dust							
Unpaved roads	4.0 lb/VMT	1.5 mi; ADT=21; 365 da/yr	23	1.0	23	1.0	23
Paved roads	0.04 lb/VMT	18.4 mi; 3.3x10^6 VMT/yr	66	1.34	88	1.5	99
Road sanding	0.003 lb/VMT	18.4 mi; 3.3x10^6 VMT/yr	5	1.34	7	1.5	8
Cleared/Storage area	0.26 ton/ac/yr	1.0 ac	neg	1.0	neg	1.0	neg
Playground/ball field	0.26 ton/ac/yr	3.0 ac	1	1.0	1	1.0	1
Conventional							
Point source	--	--	neg	--	neg	--	neg
Stationary source fuel combustion	--	grid/county popl = .08[b]	3	1.03	3	1.14	3
Mobile sources	--	[c]	5	1.07	5	1.03	5
Combustion of solid wastes	--	incinerators/grid	1	1.0	1	1.0	1
Total			104	1.23	128	1.35	140
Emission density, ton/sq mi/yr			69		85		93

[a] GF = growth factor (see Area Source Inventory)

[b] multiply by county emissions (see Area Source Inventory)

[c] multiply by county emissions: grid/county VMT = .011; grid/county const develop = .05

Table B-4. RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATE

Grid No. 4
Description: Northwest city, mineral products industries area
Area of grid, sq mi: 2.23

Source category	Emission factor	Emission level parameters	Particulate emissions, ton/yr 1974	GF[a]	1980	GF	1985
Fugitive dust							
Unpaved roads	4.0 lb/VMT	7.8 mi; ADT=21; 365 da/yr	120	1.0	120	1.0	120
Paved roads	0.04 lb/VMT	6.3 mi; 1.1×10^6 VMT/yr	22	1.34	29	1.5	33
Unpaved shoulders	0.3 ton/ac/yr	1.1 mi; or (2.7 ac)	1	1.34	1	1.5	2
Road sanding	0.003 lb/VMT	6.3 mi; 1.1×10^6 VMT/yr	2	1.34	3	1.5	3
Unpaved parking lot	0.29 ton/ac/yr	14 ac	4	1.0	4	1.0	4
Cleared/Storage area	0.26 ton/ac/yr	31 ac	8	1.0	8	1.0	8
Gravel pits	9.4 ton/ac/yr	270 ac	2538	1.14	2893	1.24	3147
RR rights-of-way	0.3 ton/ac/yr	3.5 mi; or (17 ac)	5	1.0	5	1.0	5
Aggregate storage	9.4 ton/ac/yr	45 ac	423	1.0	423	1.0	423
RR yards	0.3 ton/ac/yr	5.0 ac	2	1.0	2	1.0	2
Conventional							
Point source	--	--	3104		1264		1454
Stationary source fuel combustion	--	grid/county popl = .07[b]	2	1.03	2	1.14	2
Mobile sources	--	[c]	7	1.07	7	1.03	7
Combustion of solid wastes	--	incinerators/grid	2	1.0	2	1.0	2
Total			6240	0.71	4763	0.76	5212
Emission density, ton/sq mi/yr			2798		2136		2337

[a] GF = growth factor (see Area Source Inventory)

[b] multiply by county emissions (see Area Source Inventory)

[c] multiply by county emissions: grid/county VMT = .008; grid/county RR mi = .089; grid/county const develop = .087

Table B-5. RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATE

Grid No. 5
Description: Main district, west of Hangman Hill
Area of grid, sq mi: 0.77

Source category	Emission factor	Emission level parameters	Particulate emissions, ton/yr 1974	GF[a]	1980	GF	1985
Fugitive dust							
Unpaved roads	4.0 lb/VMT	2.5 mi; ADT=21; 365 da/yr	38	1.0	38	1.0	38
Paved roads	0.04 lb/VMT	11.5 mi; 2.1x10^6 VMT/yr	42	1.34	56	1.5	63
Unpaved shoulders	0.3 ton/ac/yr	1.3 mi; or (3.2 ac)	1	1.34	1	1.5	2
Road sanding	0.003 lb/VMT	11.5 mi; 2.1x10^6 VMT/yr	3	1.34	4	1.5	5
Unpaved parking lots	0.29 ton/ac/yr	2.0 ac	1	1.0	1	1.0	1
Cleared/Storage area	0.26 ton/ac/yr	2.0 ac	1	1.0	1	1.0	1
RR rights-of-way	0.3 ton/ac/yr	1.1 mi; or (5.3 ac)	2	1.0	2	1.0	2
Aggregate storage	9.4 ton/ac/yr	2.0 ac	19	1.0	19	1.0	19
Playground/ball field	0.26 ton/ac/yr	1.0 ac	neg	1.0	neg	1.0	neg
Conventional							
Point source	--	--	8		10		10
Stationary source fuel combustion	--	grid/county popl = .09[b]	3	1.03	3	1.14	3
Mobile sources	--	c	12	1.07	13	1.03	12
Combustion of solid wastes	--	incinerators/grid	2	1.0	2	1.0	2
Total			132	1.12	150	1.18	159
Emission density, ton/sq mi/yr			171		195		206

[a] GF = growth factor (see Area Source Inventory)
[b] multiply by county emissions (see Area Source Inventory)
[c] multiply by county emissions: grid/county VMT = .008; grid/county const develop = .174

Table B-6. RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATE

Grid No. 6
Description: Southwest city, Canyon Lake/Sioux Park area
Area of grid, sq mi: 3.18

Source category	Emission factor	Emission level parameters	Particulate emissions, ton/yr 1974	GF[a]	1980	GF	1985
Fugitive dust							
Unpaved roads	4.0 lb/VMT	0.9 mi; ADT=21; 365 da/yr	14	1.0	14	1.0	14
Paved roads	0.04 lb/VMT	26.4 mi; 4.7x10^6 VMT/yr	94	1.34	126	1.5	141
Active construction	6.4 ton/ac/yr	10 ac	64	1.14	73	1.24	79
Unpaved shoulders	0.3 ton/ac/yr	0.4 mi; or (1.0 ac)	neg	1.34	neg	1.5	neg
Road sanding	0.003 lb/VMT	26.4 mi; 4.7x10^6 VMT/yr	7	1.34	9	1.5	11
Unpaved parking lots	0.29 ton/ac/yr	1.0 ac	neg	1.0	neg	1.0	neg
Playground/ball field	0.26 ton/ac/yr	40 ac	10	1.0	10	1.0	10
Conventional							
Point source	--	--	neg		neg		neg
Stationary source fuel combustion	--	grid/county popl = .09[b]	3	1.03	3	1.14	3
Mobile sources	--	c	11	1.07	12	1.03	11
Combustion of solid wastes	--	incinerators/grid	1	1.0	1	1.0	1
Total			205	1.21	248	1.32	270
Emission density, ton/sq mi/yr			64		78		85

[a] GF = growth factor (see Area Source Inventory)
[b] multiply by county emissions (see Area Source Inventory)
[c] multiply by county emissions: grid/county VMT = .014; grid/county const develop = .130

Table B-7. RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATE

Grid No. 7
Description: Northeast city, residential zones
Area of grid, sq mi: 1.95

Source category	Emission factor	Emission level parameters	Particulate emissions, ton/yr 1974	GF[a]	1980	GF	1985
Fugitive dust							
Unpaved roads	4.0 lb/VMT	4.8 mi; ADT=21; 365 da/yr	74	1.0	74	1.0	74
Paved roads	0.04 lb/VMT	30.7 mi; 5.5×10^6 VMT/yr	110	1.34	147	1.5	165
Active construction	6.4 ton/ac/yr	35 ac	224	1.14	255	1.24	278
Road sanding	0.003 lb/VMT	30.7 mi; 5.5×10^6 VMT/yr	8	1.34	11	1.5	12
Unpaved parking lots	0.29 ton/ac/yr	1.0 ac	neg	1.0	neg	1.0	neg
RR rights-of-way	0.3 ton/ac/yr	1.5 mi; or (7.3 ac)	2	1.0	2	1.0	2
Aggregate storage	9.4 ton/ac/yr	10 ac	94	1.0	94	1.0	94
Playground/ball field	0.26 ton/ac/yr	15 ac	4	1.0	4	1.0	4
Conventional							
Point source	--	--	325	0.21	85	0.21	97
Stationary source fuel combustion	--	grid/county popl = .13[b]	5	1.03	5	1.14	6
Mobile sources	--	c	17	1.07	18	1.03	18
Combustion of solid wastes	--	incinerators/grid	2	1.0	2	1.0	2
Total			865	0.79	697	0.84	752
Emission density, ton/sq mi/yr			443		357		386

[a] GF = growth factor (see Area Source Inventory)

[b] multiply by county emissions (see Area Source Inventory)

[c] multiply by county emissions: grid/county VMT = .018; grid/county const develop = .217

Table B-8. RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATE

Grid No. 8
Description: East city, industrial/commercial strip area
Area of grid, sq mi: 2.90

Source category	Emission factor	Emission level parameters	Particulate emissions, ton/yr 1974	GF[a]	1980	GF	1985
Fugitive dust							
Unpaved roads	4.0 lb/VMT	6.6 mi; ADT=21; 365 da/yr	101	1.0	101	1.0	101
Paved roads	0.04 lb/VMT	25.0 mi; 4.5x10^6 VMT/yr	90	1.34	121	1.5	135
Road sanding	0.003 lb/VMT	25.0 mi; 4.5x10^6 VMT/yr	7	1.31	9	1.5	11
Unpaved parking lots	0.29 ton/ac/yr	6.0 ac	2	1.0	2	1.0	2
Cleared/Storage area	0.26 ton/ac/yr	7.0 ac	2	1.0	2	1.0	2
RR rights-of-way	0.3 ton/ac/yr	3.8 mi; or (18.4 ac)	6	1.0	6	1.0	6
Aggregate storage	9.4 ton/ac/yr	2.0 ac	19	1.0	19	1.0	19
RR yards	0.3 ton/ac/yr	12 ac	4	1.0	4	1.0	4
Playground/ball field	0.26 ton/ac/yr	5.0 ac	1	1.0	1	1.0	1
Grain elevator	1.8 ton/silo/yr	2.0 ac	4	1.0	4	1.0	4
Conventional							
Point source	--	--	neg		neg		neg
Stationary source fuel combustion	--	grid/county popl = .09[b]	3	1.03	3	1.14	3
Mobile sources	--	c	8	1.07	9	1.03	8
Combustion of solid wastes	--	incinerators/grid	1	1.0	1	1.0	1
Total			248	1.14	282	1.20	297
Emission density, ton/sq mi/yr			86		97		102

[a] GF = growth factor (see Area Source Inventory)

[b] multiply by county emissions (see Area Source Inventory)

[c] multiply by county emissions: grid/county VMT = .016; grid/county RR mi = .165; grid/county const develop = .044

Table B-9. RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATE

Grid No. 9
Description: Central district, east of Hangman Hill
Area of grid, sq mi: 1.19

Source category	Emission factor	Emission level parameters	Particulate emissions, ton/yr				
			1974	GF[a]	1980	GF	1985
Fugitive dust							
Unpaved roads	4.0 lb/VMT	0.7 mi; ADT=21; 365 da/yr	11	1.0	11	1.0	11
Paved roads	0.04 lb/VMT	18.9 mi; 3.4x10^6 VMT/yr	68	1.34	91	1.5	102
Active construction	6.4 ton/ac/yr	3.0 ac	19	1.14	22	1.24	24
Road sanding	0.003 lb/VMT	18.9 mi; 3.4x10^6 VMT/yr	5	1.34	7	1.5	8
Unpaved parking lots	0.29 ton/ac/yr	4.0 ac	1	1.0	1	1.0	1
RR rights-of-way	0.3 ton/ac/yr	2.1 mi; or (10.2 ac)	3	1.0	3	1.0	3
RR yards	0.3 ton/ac/yr	20 ac	6	1.0	6	1.0	6
Playground/ball field	0.26 ton/ac/yr	3.0 ac	1	1.0	1	1.0	1
Grain elevator	1.8 ton/silo/yr	6.0 ac	11	1.0	11	1.0	11
Conventional							
Point source	--	--	35	1.0	35	1.0	35
Stationary source fuel combustion	--	grid/county popl = .13[b]	5	1.03	5	1.14	6
Mobile sources	--	[c]	9	1.07	10	1.03	9
Combustion of solid wastes	--	incinerators/grid	2	1.0	2	1.0	2
Total			176	1.16	205	1.24	219
Emission density, ton/sq mi/yr			147		172		184

[a] GF = growth factor (see Area Source Inventory)
[b] multiply by county emissions (see Area Source Inventory)
[c] multiply by county emissions: grid/county VMT = .01; grid/county RR mi = .231; grid/county const equip = .087

Table B-10. RAPID CITY GRID EMISSIONS AND EMISSION DENSITY ESTIMATE

Grid No. 10
Description: Southeast city, residential district
Area of grid, sq mi: 3.11

Source category	Emission factor	Emission level parameters	Particulate emissions, ton/yr 1974	GF[a]	1980	GF	1985
Fugitive dust							
Unpaved roads	4.0 lb/VMT	0.9 mi; ADT=21; 365 da/yr	14	1.0	14	1.0	14
Paved roads	0.04 lb/VMT	37.8 mi; 6.8×10^6 VMT/yr	136	1.34	182	1.5	204
Unpaved shoulders	0.3 ton/ac/yr	0.7 mi; or (1.7 ac)	neg	1.34	neg	1.5	neg
Road sanding	0.003 lb/VMT	37.8 mi; 6.8×10^6 VMT/yr	10	1.34	13	1.5	15
Unpaved parking lots	0.29 ton/ac/yr	10 ac	3	1.0	3	1.0	3
Playground/ball field	0.26 ton/ac/yr	3.0 ac	1	1.0	1	1.0	1
Conventional							
Point source	--	--	neg		neg		neg
Stationary source fuel combustion	--	grid/county popl = .15[b]	5	1.03	5	1.14	6
Mobile sources	--	c	11	1.07	12	1.03	11
Combustion of solid wastes	--	incinerators/grid	1	1.0	1	1.0	1
Total			181	1.28	231	1.41	255
Emission density, ton/sq mi/yr			58		74		82

[a] GF = growth factor (see Area Source Inventory)
[b] multiply by county emissions (see Area Source Inventory)
[c] multiply by county emissions: grid/county VMT = .020; grid/county const equip = .087

APPENDIX C

SOUTH DAKOTA PARTICULATE AIR QUALITY DATA

Table C-1. SOUTH DAKOTA PARTICULATE AIR QUALITY DATA[a]

Station number/ Location	Dates of operation	Data yr of record	No of samples	Annual ug/m^3		1st Qtr, ug/m^3		2nd Qtr, ug/m^3		3rd Qtr, ug/m^3		4th Qtr, ug/m^3	
				mean[b]	max[c]	mean[b]	max[c]	mean[b]	max[c]	mean[b]	max[c]	mean[b]	max[c]
18/Sioux Falls Municipal Airport	4/72-present	1974	57	47.3	121.0	47.0	68.4	46.0	65.9	51.4	86.8	45.2	121.0
17/Sioux Falls Wastewater Treatment	4/72-present	1974	52	61.3	153.3	54.6	79.2	70.0	92.9	65.8	86.5	58.0	153.3
01/City Hall Sioux Falls	d	1974	d	50.4	130.0	d	d	d	d	d	d	d	d
19/Augustana College, Sioux Falls	2/75-present	1975	38	49.9[e]	113.3	39.3	54.1	46.7	87.3	56.9	85.0	64.9[f]	60.8
8/Ken Freize Enterprises, Rapid City	12/74-present	1975	55	165.7[e]	556.6	65.1	103.5	158.8	492.2	315.8	716.3	262.2[f]	598.4
9/State Cement Plant, Rapid City	1/75-present	1975	51	363.7[e]	1101.	155.8	343.0	385.6	862.0	420.2	1101.	589.2[f]	902.8
6/Rapid City Water Treatment Plant	4/72-present	1974	44	61.2	119.2	60.6	119.2	49.9	69.1	62.0	87.0	74.8	99.9
7/Pennington County Health Dept, Rapid City	4/72-present	1974	41	111.7	211.8	139.4	211.8	97.5	137.1	101.0	151.8	120.5	162.3

[a] 1974 Particulate Readings, South Dakota Department of Environmental Protection, Air Monitoring Program, Unpublished, [b] geometric; [c] maximum value = second highest; [d] data unavailable/ NASN station; [e] ten month sample average (geometric), 1974 data unavailable; [f] one month sample average (geometric).

APPENDIX D

EMISSION FACTORS APPLIED TO MICROINVENTORY ANALYSES OF FUGITIVE DUST SOURCES

Table D-1. EMISSION FACTORS APPLIED TO MICROINVENTORY ANALYSES OF FUGITIVE DUST SOURCES

Source category	Emission factors South Dakota	 Nevada	 Wyoming	 Kansas/Nebraska
Unpaved roads	4.0-4.4 lb/VMT	4.7-5.3 lb/VMT	1.9-5.8 lb/VMT	3.7 lb/VMT
Paved roads	0.002-0.04 lb/VMT	0.004 lb/VMT	0.06 lb/VMT	-
Agriculture	0.03 ton/ac/yr	-	-	0.04-0.16 ton/ac/yr
Road sanding	0.003 lb/VMT	-	0.004 lb/VMT	-
Unpaved parking lots	0.23-0.29 ton/ac/yr	0.65-0.74 ton/ac/yr	-	-
Railroad rights-of-way	0.2-0.3 ton/ac/yr	0.2-0.9 ton/ac/yr	-	0.2 ton/ac/yr
Unpaved shoulders	0.2-0.3 ton/ac/yr	-	1.9 lb/VMT	1.9 lb/VMT
Cleared/storage areas	0.17-0.26 ton/ac/yr	0.32-1.34 ton/ac/yr	-	0.36 ton/ac/yr
Aggregate storage	-	-	-	7.5 ton/pile/yr
Active construction	2.8-6.4 ton/ac/yr	12.0 ton/ac/yr	-	3-6 ton/ac/yr
Gravel pits	4.1-9.4 ton/ac/yr	1.14-3.4 ton/ac/yr	-	1 ton/ac/yr
Playgrounds	0.26 ton/ac/yr	1.5-2.5 ton/ac/yr	-	-
Grain elevators	1.8 ton/silo/yr	-	-	1.8-2 ton/silo/yr (about 10 ton/yr)

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